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U. S. S. R.

THE RAILWAY NETWORK

DECEMBER 1952

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I N D E X

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F O R E W O R D

1 - This study has been drawn up by using:

- Soviet railway time-tables of 1949 and 1950;
- Soviet atlas;
- a railway map of European Russia drawn up by the German General Staff;

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- anticipations and results of the Soviet five-year plans;
- news from the Soviet and international press;
- information which can't be controlled from different sources;

2 - The general conclusions arrived at are to be considered reliable enough.

The numerical data and the technical details are on the contrary to be considered of different reliability.

As an instance:

- the data concerning the consistence of the railway park are to be considered only for guidance;
- the data about the railway system and everything concerning the type of lines (number of tracks, traction) used at the end of 1949 are to be considered reliable enough;
- everything concerning the conditions of the lines (number of tracks, permanent ways, traction, existence of block systems) used at the end of 1951 has to be confirmed;
- the data concerning the traffic are partly reliable and partly resulting from conjectures.

The study tries to present a general view - in some fields we have gone deeply into - of the Soviet railway transportations as they were according to information prior to Summer 1952.-

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I - A SHORT HISTORICAL ACCOUNT -

The Russian railway system, built up in a period when the country had as characteristic a power strongly centralized and few and very far centres of political, industrial, agricultural and commercial life, could develop itself but along radial lines which connected these centres with the power's seats and those of the political and industrial life of the country: Peterburg and Moscow.

The long distances to be covered, the consequent high installation costs and the nature of the ground completely lacking of bed, compelled them to build up almost exclusively single-track lines, with stations and traffic points far from each other and without ballast.

As in consequence of the industrial and economic development of some peripheric zones the big radial lines were connected to secondary ones (often built without any uniformity by trusts or big industrial concerns) the initial construction deficiencies began to show themselves and they were not able to timely repair them. The first consequences of this fact appeared in 1904 and 1905, during the Russian-Japanese war, which showed the incapacity and backwardness of the Transiberian railway.

For strategical reasons, the railway system of Western Russia was more developed between the end of the XIX century and the first years of XX by building a thicker system and increasing the capabilities of the lines. But this railway system too did not stand the test of World War I. In spite of the efforts made in that period, both this system and the whole one built by the Czars showed their impotence to meet the exceptional needs.

The Soviet regime arisen from the revolution of 1917 and the following civil war found the railway system partly destroyed and partly disorganized. The railway system conditions were such that on the beginning it was not possibile to start an organical rebuilding plan.

From the other side, the new regime, by deeply changing the economical and social conceptions existing during the czarist regime, changed too the economical relations among the different regions, which had become republics almost independent from the economical standpoint.

As for the railway traffic, this fact brought about sweeping changes.

Owing to the new course, it was in fact necessary to look:

- to increase the capability of the already existing radial lines;
- to develop the railway system of each region to meet the requirements of the new industries and agriculture;
- to build sidings among the systems of contiguous regions to increase exchanges by reducing the run;
- to let the railways arrive in those regions which had not any and that they planned to develop economically.

During the twenty years elapsed between 1921 and 1941, and especially during the second and third five-year plans, the Soviet regime, though facing heavy difficulties, tried to meet the requirements caused by the new economical system either by partially renewing the rolling stock or by rebuilding, developing and renewing other lines.

The results achieved, considering also the local factors, were in general satisfactory, though not yet such as to permit

to meet the increasing needs of the traffic and the agricultural and industrial development of the regions which were gradually developed.

World War II, besides causing nearly the total destruction of the lines, bridges and installations of the railway network in the territories occupied by the Germans, and the loss of considerable rolling equipment, compelled to overlook all the other lines, which in consequence lacked the necessary maintenance and the permanent way renewal. It resulted a quicker wear of the rolling stock.

The reconstruction works, begun as the territory was reconquered, received a definite guidance in 1946 with the first postwar five-year plan, by which new constructions were given a considerable impulse.

The results attained during the last five years are partly known, but what can be deduced from the traffic data published by official Soviet sources and what is generally known about the Soviet railway system seems to prove that the latter is at present in a position as to follow the economical and industrial development of the country.

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II - LOCAL CONDITIONS -

The large Russian territories present, as regards the system and operation of the railway network, the following characteristics:

- prevailingly flat ground except in some border zones (Carpathian Mountains, Caucasus, Turkestan, Altai). The same Ural Mountains, which greatest width is of 150 km., do not represent a uniform chain and show large and little raised passes which can be slowly reached from the western watershed, while there is a greater grade on the eastern one;
- a soil essentially formed by:
  - different kinds of grounds (gray grounds, black grounds, steppes) lacking - rocky material by which to build the ballast;
- large desert zones, often covered by sand and unfilterable dust, very harmful for gearings;
- continental climate with changes in temperature very great in the different seasons (from 40° above zero in Summer to 40° below zero in Winter) and regions;
- great courses of water generally little deep and frozen in Winter and which in the Siberian regions, during the thaw period, increase their bed and run over for many miles in the territories they pass through.

In consequence there exist:

- an easy marking out of the lines;
- an almost absolute absence of tunnels;
- a preference for the wide gauge which permits to employ heavy trains also on lines with a light permanent way laid directly on the ground owing to wantage of ballast material findable on the spot;

- different devices which are studied for permanent and mobile installations to prevent the consequences of snow, frost and dust;
- bridges on the great rivers representing the most sensitive points of the whole railway system.

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III - GENERAL VIEW OF THE RAILWAY SYSTEM -

1.- General characteristics.-

The present Soviet railway system, with its 123.000 kms. of lines, considerably suffers from:

- the geological, morphological and climatic conditions of the country;
- the political and social conditions existing when it was developed;
- the great extension on which it runs;
- the different courses which governed its construction;
- the vicissitudes of the country during last forty years;
- the problems represented by the assimilation of the newly annexed territories networks and the need of easing the communications with the western satellite countries.

It presents the following characteristics:

- 1,524 m. gauge, broader than the European standard one (1,436 m.), which causes a difficult use of the newtwork by an eventual invader;
- great use of light permanent way, directly laid without ballast on the ground as soon as leveled: it represents an advantage as installation costs and there are also low construction times;
- generally old tracks which must be renewed to get a greater capability of the lines so permitting a better preservation of the rolling stock;
- lines generally in the plain and consequently with non considerable grades permitting the use of heavy trains even with locomotives of no great power;

- generally single track lines, with stations and movement posts at a variable distance from 8 up to 30 km.;
- growing electrification near the great centres (Moscow - Leningrad), in the areas of great industrial importance (Donbas - Ural - Kusbas) and in the mountainous ones (Caucasus);
- employment of very heavy trains (1) to counterbalance the low traffic speed (2) and the limited capabilities of the lines;
- rolling stock being gradually renewed.

2.- Railway network.-

The Soviet railway network (3) appears as an ensemble of different regional networks which:

- in Western and Central Russia gravitate around Moscow, to which they are directly connected by one or more independent radial lines;
- in Eastern Russia and Asia are interdependent and generally gravitate towards the Transiberian line.

We can locate these regional networks as follows:

- Northern network;
- Finnish-Karelian network;

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(1) In 1939 the average load of goods trains was of 1.400 t. against 600 t. in France and 700 in U.S.A. It seems that in 1950 this average load reached 2.000 tons.

(2) Mean velocity of freight trains: 14,2 km/h in 1934; 16,5 km/h in 1936.

(3) See graphs A1 and A2.

- Baltic and North-Western border area network;
- Ukraine and South-Western border area network;
- Donbas network;
- Caucasus network;
- Moscow network;
- Volga network;
- Ural Mountains network;
- Turkestan network;
- Eastern Siberia network;
- Far East network.

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IV. - ROLLING STOCK -

1.- Traction equipment.-

A. - Locomotives.-

Before World War I, Russian railways used two main types of locomotives, built in Russia, with partly imported pieces:

- the type of E series for goods trains hauling, having a power of about 1.300 HP and a traction stress of 8,61 t.;
- the type of S.OU. series for passenger trains hauling.

Between 1933 and 1937, during the second five-year plan marked by the sweeping reorganization and by the effective resumption of the Soviet railway traffic, new types of locomotives were used, completely built by the Russian industry and showing some technical progress.

Among this progress it is to be noted:

- a generalized installation of high pressure boilers aiming to increase the thermal efficiency;
- an increased traction stress which from the 8,61 t. for the old E type passed to 12,89 t. for the new goods train locomotives (1);
- adoption of mechanical devices (stokers) for coal stoking and the automatic haulage from tender to furnace.

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(1) An increased traction stress was reched also by modernizing the old locomotives.

During this period, the following types started:

- F.D. for goods trains having a power of 2.500 HP, which had to replace the old E type (1);

- I.S. for passenger trains with a power of 3.200 HP, which had to replace the old S.OU. type.

The locomotives employed during the third five-year plan had the following features:

- a great traction power;

- a theoretic speed of 50-70 km/h for the goods traffic and of 80-100 km/h for the passenger traffic.

Among these locomotives it is to be particularly examined the S.O. type, a condenser tender, tested on the Transiberian line during Winter 1936-37. This type has a device for steam condensation, especially qualified to be employed in areas poor of water installations. Though the climate inclemency let fear the freezing of condensation water in the piping, these locomotives could attain a speed, varying according to the line and the cold intensity, between 36 and 42 km/h and replenish with water every 200 km. According to the builders plan, it were possibile to cover uninterrupted distances of 1.000 km.

The S.O. type weighs 62 tons (without tender), can bear a traction stress of 26 tons and develops a top speed of 75 km/h.

After the war, the Soviet industry began to build new locomotives of very high power by generally reproducing American patterns. The following types are known:

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(1) There exist two F.D. classes: the F D 21 and the F D 20, that differ for traction weight and axial load. They are locomotives 1-E-0 with rear bissel.

- L (former "Pobieda") of 82 tons (without tender) built since 1948 in the Kolomna plant. It is able to bear a traction stress of 19,2 tons, has a power of 2.100-2.200 HP and develops a top speed of 80 km/h. It can haul trains of 2.300 tons;

- O.R. 23, of 115 tons (without tender), built since 1949 in the Voroshilovgrad plant and bearing a traction stress of 23 t.

There exists also a locomotive 1 CC 2, built in the Kolomna plants, with a six-axle tender, derived from the Mallet locomotive and developing 3.000 HP. It hauls trains of 3.500 tons.

B.- Diesel locomotives.-

For the lines poor of water the Soviet industry has studied and built locomotives with Diesel engines.

The first Diesel locomotives of mass production date back from 1942 and are of the Lomonozov type of 1.150 HP. In 1934 they began to build a new type: the 2.300 HP V.M.

During the war and till 1946, USSR received also from USA a number of Diesel locomotives built by the Alco-G.E.C. and the Baldwin-Westinghouse. They were locomotives of normal type but with a 1,524 m. gauge and two six-wheel bogies (disposition of wheels: A 1 A - A 1 A), with a weight up to 120 tons, a nominal power of 1.000 HP and developing a top speed of 100 km/h.

It seems that these locomotives were used as pattern for the Soviet postwar productions.

The new built Soviet locomotives are:

- the TE - 1 - 20 - 001 type, built in the Kharkov plants, of 120 tons, with a power of 1.000 HP, bearing a traction stress of 20 tons and having a top speed of 100 km/h;

- a type of unknown denomination with a power of 2.000 HP, which would be able to haul a train of 2.200 tons on a gradient of 9°/°°.

The Soviet industry builds also at present two types of switching Diesel locomotives:

- a locomotive able to sort loads up to 120 tons and built in the Sverdlovsk tractor plant;

- a locomotive, the 150 HP T.M. 24 , built in the Kaluga works.

The lines where the use of Diesel locomotives is more frequent are those of Turkestan and Usbekistan, with a total of about 6.000 km.

C.- Traction equipment park.-

It is very difficult to draw on the subject data of considerable reliability either because those at our disposal are poor and cannot be compared, or because the official data from Soviet source are sometimes in real units (1).

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(1) The official Soviet sources, in announcing numerical data, in order to ease comparisons among quantities of locomotives of different type, often take as conventional unit the E and S.OU. types, to which they assign coefficient 1 and give:

- coefficient 1,5 to the locomotives of F.D. and I.S. type ;
- coefficient 2 to electrical locomotives.

It is unknown the coefficient assigned to Diesel and new type locomotives.

Two schedules have been drawn according to data at our disposal. Of them:

- the first shows the number and type of locomotives built since 1928 (Annex 2);
- the second shows the consistence of the traction equipment park since 1912, together with its increase in connection with the yearly output and its valuation in reference to the length of the working railway lines (Annex 3).

From the comparative examination of the data of the two schedules, it might be inferred that:

1) the 32.000 units the park is composed of, are represented by about:
   - 26.000 units (81%) built during the Soviet regime from 1928;
   - 6.000 units (19%) built before 1928.

2) Of the 26.000 more recent units:
   - 18.000 (56% of total) the types of whom are roughly known, are locomotives of great power: 2.300 - 2.500 HP;
   - 8.000 (25% of total) are of different and unknown type, having a low power.

3) Of the 18.000 units of high power:
   - 7.600 (23,7% of total) have less than five years;
   - 7.400 (23% of total) have more than five and less than 13 years;
   - 3.000 (9,3% of total) have more than 13 years.

4) Of the 14.000 units of low power (44% of total):
   - 6.000 (19% of total), as foresaid, have more than 22 years and date back in the greatest part from the Czarist period;

- of the remaining 8.000:
  - a little more than 5.000 (16% of total) have 12 up to 17 years, and
  - about 3.000 (9% of total) have 17 up to 22 years.

5) The indices given by the available number of locomotives divided for the total length of the lines and which show the availability of locomotives for every km. of line were in the prewar period of 0,21 up to 0,27 and in 1950 were of 0,26. From this it can be inferred that the availability of locomotives is at present nearly the same as in 1940.

D.- Locomotive plants.-

The industry for the traction equipment production is generally concentrated in the areas of Central Russia. Repair works are on the contrary located in almost all the regions of USSR.

In Annex 4 the known works building and repairing traction equipment are shown.

2.- Wagons.-

A.- Technical features.-

a) Freight cars. - The freight cars existing during the period of World War I were almost all six-axle cars having an average carrying capacity of 15 t. The mass production of four-axle cars started only during the first five-year plan.

The following five-year plans planned the production of only four-axle cars having an average carrying capacity from 50 up to 60 tons. Since 1937 the Soviet industry has tried to reach the one of the Western countries in the railway cars production

and it has succeeded to put in service special cars of modern type: self-unloading cars of 65 t., cars for cattle transportation, wagons for live fish transportation, isothermal wagons, gondola cars of 100 t., bascule cars for bitumen transportation and other uses.

According to the present tendency, these wagons have a steel casting chassis with welded parts. They have also automatic brakes and a self-coupling system.

At present, 93% of cars have automatic brakes and 75% the self-coupling system.

The cars length varies from m. 6,40 for the two-axle cars up to m. 36 for some special ones (probably the gondola cars).

b) Coaches - Most of the coaches used before World War I were m. 18 long and weighed 38 tons. The first and second class coaches had room for 24 beds, while those of third class had room for 56 seats or 42 beds.

The production of these coaches was interrupted during World War I and the civil war, and was started again only on 1926-27. On the beginning, the production was very low (726 in 1927), so that a real park renewal was begun towards 1932, at the end of the first five-year plan.

Materials underwent technical improvements only during the third five-year plan.

The new building courses brought to the construction of coaches having the following general features:

- length: m. 25,2;
- all metallic construction, by using special welded steels;

- streamline;
- automatic brakes and self-coupling system;
- electric lighting and conditioned heating or air.

Passenger cars differ according to their employment on the great lines, the local lines or the peripheric lines of great towns. The first have all room for beds, while the others have springy seats or not.

The still used old coaches are generally employed on the regional lines. But they are often used in the same trains together with new ones.

B.- Cars park.-

a) Goods trains park.- According to information partly from Soviet official source and partly drawn from technical international works, a table has been drawn up (See Annex 5) which shows the consistence of Soviet goods cars park during last 40 years.

From this table, the details for the drawing up of which are specified in the foot notes, we can draw data that, though not exact, are generally of good reliability.

From these data we infer that:

- the Soviet goods cars park is composed of about 908.000 real units, of which 48,4% (430.000) is represented by two-axle cars having an average carrying capacity of more than 50 tons;
- the two-axle cars were all built before 1938 and at least half of them were built before 1917.

Among the four-axle cars:

- 255.000 (28% of total) were built after 1945;
- the remaining cars have nearly all less than 20 years, while the oldest are of 1928;
- according to the fourth five-year plan previsions, the yearly production of goods cars after 1950 amounts to about 150.000 conventional units per year, corresponding to nearly 80.000 four-axle cars.

b) Coaches park.- The information at our disposal are poor and conflicting. The most reliable have been summarized in Annex 6.

From these data we note that:

- were the coaches built before the Soviet regime really condemned, on 1951 the park had to dispose of about 30.000 units;
- in the most probable case that these coaches have not been condemned but only set aside for an emergency period, the park had to dispose in the same time of about 41.000 units;

of the comparatively 3.000 modern coaches:

- about 18.000 (60%) have less than 12 years;
- about 12.000 (40%) have 35 up to 13 years;
- the construction of coaches during the fourth and last five-year plan has been equal to the 50% of the one of the third, and this confirms the Soviet trend to direct towards air lines the passenger traffic on the great distances.

c) Rolling stock factories.-

At the beginning of XX century, there existed in Russia 15 factories and assembly plants of railway material, eight of which new built ones.

In 1927, when since some years after the war period the rolling stock production was also started again, the working plants, on the contrary, were only 11.

It was only during the second five-year plan, when the railway material was greatly increased, that they began to equip new factories.

Among the factories and workshops existing to-day, those shown in Annex 7 are known.

3.- Considerations.-

In general, according to official information, the Soviet railway park would have at present two main features:

- in course of being renewed: the 46,7% of locomotives would have less than 13 years, the 28% of goods cars would have less than 6 years, the 60% of passenger cars would have less than 12 years with a yearly increase - in real units -of 2.300 locomotives, 80.000 goods cars of 50 tons and 1.250 passenger cars;
- it is formed, as the modern material is concerned, of high power locomotives and of great carrying capacity goods and passenger cars, and this owing to the marked tendency to prefer very heavy trains (an average of 2.000 tons).

On the other hand it includes very old equipment: the 19% of locomotives has more than 23 years and generally more than 35, the 23% of goods cars are two-axle cars and have more than 35 years.

It follows that the Soviet park is at present scarcely homogenous and while it permits the use on the great lines of very heavy and modern trains, it compels them to use on the other lines comparatively heavy trains but built with obsolete material needing frequent repairs.

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V.- THE RAILWAY LINES -

1.- Before 1941.-

The great distances to be covered, the ground nature, often the impassableness and absence of driving-roads in the area, the poor initial traffic and the deficiency of capitals induced the Russians, during the Czarist period, to build quite rudimental railway lines.

The greatest part of the lines in that period and also some-one of those more recently built (1) were built by directly laying tracks on the ground as soon as it was leveled and so starting at once the working. They completed afterwards the bridges and other permanent works.

At the end of the works, these lines were formed by sand or similar materials (seldom gravel), by wood sleepers (1.440 per km.) connected to rails by simple track rivets, stiffening tie-plates applied only in the greatest curves and by tracks which in the stations were often of iron. On the lines there were steel tracks but had a weight nearly always less than kg. 38 per metre (2).

We can so explain that, though being great communcation lines more rationally built, till 1934 the mean velocity of goods trains was of km. 14,2 per hour and the passenger trains one of km. 23,7.

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(1) For instance: the Dezhevka - Komsomolsk in the Far East.

(2) In 1935 the 2% of tracks weighed kg. 43 per metre, the 16% kg. 38 and 82% less than kg. 38.

1934 was marked in the same time by the greatest transportation crisis, which followed to the industrial improvement that took place in Russia after the end of civil war, and the beginning of the railway lines renewal. As the crisis of transportations had been caused by the impossibility of rapidly clearing the traffic among the big industrial centres (1), Kaganovich, who was appointed head of the Communication Commissariat and obtained enough means and manpower, faced the problem by beginning and ending within 1937 the renewal and modernization of a little number of principal lines, along which he concentrated the traffic of raw materials, fuels and building material, from which the whole industrialization programme of the country depended.

These lines were those connecting the Donetz basin with Moscow and Leningrad and the Kuznetsk basin with the Ural Mountains and Moscow.

Along these lines, and only along them, double tracks, where they did not exist, were laid, and longer and heavier rails (2), with automatic switch and block systems were set up.

When the transportation crisis was overcome, thanks to the increased capabilities of these few lines, the Soviet Government reduced materials and manpower allotted to railways to send them to other branches of industry.

In consequence, in 1940 there existed a great carrying capacity difference between the old and the renewed lines of the Soviet railway system.

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(1) From 1931 up to 1934, about 15-20 tons of goods stopped in the stations.

(2) The new lines had tracks weighing 43 kg. per metre, 1.800 sleepers per km. and stiffening tie-plates along the whole line.

In that period, 24.900 km. out of nearly 106.000 had double tracks, about 20.000 had a heavy permanent way, 8.400 had automatic installations and 1.870 had electric traction.

It is interesting to note that of these 106.000 km., 70.740 had been inherited from the Czarist regime, 16.570 had been added to the Soviet network following the annexations of the western border territories and 18.790 had been built by the Soviet Government.

The new constructions concerned almost exclusively the Asiatic regions.

2.- During the war period.-

War operations on Soviet territory caused the almost complete destruction of the railway network of occupied territories. As a whole, this destruction concerned:

- 52.400 km. of lines;
- 17.513 km. of secondary tracks;
- 2.342 bridges of great and medium length;
- 4.100 railway stations with their installations;
- 317 roundhouses.

The rebuilding of the destroyed lines and installations was made as the territory was reconquered, so that in 1943 about 19.000 km. had been already built and in 1945 about 49.000 km. and 1.850 bridges.

But it was a hasty rebuilding and was made by using as far as possibile salvaged materials.

Besides that, all the double-track lines were rebuilt with one track only. In consequence, the capability of the rebuilt lines was in general lower than that of the old ones.

On the contrary, in the occupied territories they increased the capabilities on the principal lines, completed the complementary and inter-regional lines begun before invasion, and rapidly built lines to be used for the exploitation of zones having new industrial or mining resources or for backing military operations.

So between 1940 and 1945 were built new lines for about 11.000 km. Among these lines a special attention must be devoted, owing to its importance, to the Along-the-Volga line, which follows the Volga valley along the western bank between Stalingrad and Kazan and which in 1945 was almost completed and working.

At the end of the war and before the beginning of the fourth five-year plan works, the Soviet railway lines had a longitudinal development of 112.868 km., of which:

- 21.000 km. double tracked;
- 6.950 km. having signalling apparatus for automatic blocking;
- 2.038 km. of electrified lines.

3. - At the end of the fourth five-year plan.-

A - The programme of the fourth five-year plan.- In the first postwar five-year plan, the Soviet Government, after having stressed the importance of giving the priority to the railway reconstruction, allotted to railways the 16% of the funds to be invested during the period 1946-1950. But this percentage is slightly higher than the investments average during the period 1928-1940 and is lower than the one fixed in the yearly plan of 1935 corresponding to the period of the transportation crisis. This demonstrates that in 1945 the situation of railway transportations was considered less troubling than in 1935.

The funds allotted had to serve for executing, in the field of permanent installations, the following reconstruction programme: (See also Annex 8):

1)- to complete within 1948 the general reput in service of the railway lines of the Donetz and Krivoi Rog minerary basins, and of the lines connecting Moscow with Leningrad, with the Donbas and Caucasus along a longitudinal development of 15.000 km.;

2)- to reput in service and build ex novo o. the railway lines of the former invaded territories, 1.800 bridges, 1.500 railway stations, 1.300 roundhouses, 128 wagon depots and repair shops;

3)- to fully reactivate the railway system of the former invaded territories and in the same time:

- to increase the prewar level of the following lines capabilities:

Moscow - Donbas	(1.100 km.)
Donbas - Krivoi Rog	(440 km.)
Moscow - Rostov - Caucasus	(about 2.500 km.)
Moscow - Leningrad	(651 km.)
Moscow - Kiev - Lwow	(1.500 km.)
Moscow-Smolensk-Minsk-Kaliningrad	(1.289 km.)
Moscow-Veliki Luki-Riga	(922 km.)
Moscow-Gorki-Kirov-Sverdlovsk-Omsk	(2.453 km.)

- to complete and improve the Donbas Along-the-Volga line: Likaia-Stalingrad-Ilovlia-Saratov-Sizran-Kazan (1.500 km.)

4)- to build and renew secondary tracks for a total of 12.500 km.

5)- to electrify 5.325 km. of railway lines;

6)- to build new railway lines for a total of 7.230 km. (including the Stalinsk -Pavlodar - Akmolinisk - Magnitogorsk line);

7)- to set up automatic signalling apparatus along 14.000 km. of railway lines;

8)- to lay on the existing railway lines 50.000 km. of new heavy rails (1) by which to renew 32.000 km. of railway lines (3.000 to be rebuilt and 29.000 to be renewed).

In the programmes of the fourth five-year plan no specific hint was included to the works required to bring the lines of the annexed territories in the west - which had a gauge of m. 1,435 - to the gauge of m. 1,524 existing in the Soviet Territory.

The Soviet Government has been very laconic about the realizations of this plan.

On April 1951, the official Soviet sources limited themselves to say that it had not been fully achieved. About the effective realizations of the different points of the programme, we have the following information (not always from fully reliable sources).

B - Reconstruction, improvement, double-track lines - (Points 1) 2) 3) 4) of the programme.- According to the official communication of the Central Committee for Plans, the works concerning the reconstruction of the secondary tracks, railway stations and junctions had been executed only on the main lines.

A careful and detailed study of the Soviet railways official time-table for 1950 stresses that also some principal lines along which the second track had to be reactivated or built ex novo, in the period when the time-table was drawn up, still had only a track:(the Moscow-Briansk-Kharkov line; the Briansk-Bakhmasc line; the Moscow-Riga line; the Gorki-Kirov-Molotov-Sverdlovsk-Tiumen-Omsk line and others).

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(1) R.50 type.

The lines which according the interpretation given to indications of the fourth five-year plan, would have a double track, are shown in Annex n. 9. Their total development is of 33.440 km., that is to say slightly inferior to the 33.500 km. which would result from the sum of the 21.000 km. existing in 1945 and the 12.500 km. contemplated by the plan.

C - Electrification (Point 5 of the plan)

See the chapter concerning the Electrical Traction.

D - New constructions (Point 6 of the programme).- The condition of the works on the new lines planned in 1946 or which in that period were still under construction and had to be ended within 1950, is shown in Annex n. 10.

E - Automatic signalling apparatus (Point 7 of the programme)

We have not on the subject exact information either about the consistence of installations or the lines along which they have been setoup.

It can be presumed that the lines shown in the Annex n. 11 and which have a longitudinal development of 19.212 km. have automatic signalling.

It must be remembered that according the fourth five-year plan the total of the lines having automatic signalling would be of km. 20.950 (km. 6.950 existing in 1945 and 14 km. contemplated by the plan).

F - Renewal of the permanent way.(Point 8 of the programme)

We lack reliable information..We can however presume that at least within 1951 the planned programme has been partially executed.

It is difficult to assess how it has been executed and which really are the lines having a heavy permanent way or at least a comparatively modern one.

In the Annex n. 12 are shown lines for a total of 42.601 km. which can be supposed to have such a kind of permanent way.

G - Works in the annexed territories in the west.- In 1940, following annexations agreed on with the German Government, while for some lines the trasnformation was accomplished or was underway, on someones having a double track only a track was transformed and many others were left with the European gauge.

It seems that after the war, in the annexed territories the transformation into Soviet gauge was executed in almost all the occupied territories (1).

H - Capabilities of the lines - We have not enough elements to assess the capabilities of each line at the end of the works contemplated by the fourth five-year plan.

In the graphs A1 e A2 is shown the capability of each railway section of Western Russia lines and of each railway section of the remaining territory principal lines, calculated on the basis of the lines condition at the end of 1949.

In graphs C1 - C2 is shown the capability of the USSR principal lines estimated on the basis of the lines supposition at the end of 1951.

4. - Considerations.-

It is difficult to have an exact sensation about the condition of the USSR railway lines. It must be stated beforehand

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(1) Excepting perhaps some local lines of the Baltic Republics.

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that what can be said on the subject is the result of argomentations drawn from the poor information from official Soviet source and from not always reliable press news.

We think however it can be presumed that:

- the damages caused by war would have been partly repaired, excepting what concerns the equipment of some stations and some lines of Western Russia which originally were double-line and have been rebuilt as single track;
- the present longitudinal development of railways would run about to 123.000 km., of which:
  - 33.000 (26,8%) double-line;
  - 20.000 (16%) with automatic block signalling apparatus;
  - 45.000 (36,5%) having a new or recently renewed heavy permanent way;
  - an indetermined number, probably amounting to at least 40% of total, having light permanent way (with rails weighing less than 38 kg. per metre), without ballast and not renewed since long time;
  - while the big communication roads with the European countries and the internal ones connecting the big industrial centres are modernly enough equipped and have good traffic capabilities, most of the internal secondary lines or of Asiatic regions (Turkestan, Central Siberia, Far East) are equipped in a rudimental way and have a very limited traffic capability;
  - works aiming to improve the condition of the oldest lines are underway;
  - big construction works are underway only in the Asiatic regions, where they are trying to exploit new territories and to connect in a better way those industrially more developed.

It seems consequently that the railway lines system too, like the rolling stock one, lacks homogeneousness and is now in course of being renewed or improved.

VI - ELECTRIC TRACTION -

1.- The evolution of electrification.-

During the Czarist period did non exist railway lines with electric traction. A project concerning a line in the Peterbourg outskirts was not carried out.

A first plan of electrification studied in 1921 concerning a line of 3.860 km. to be finished in 9 years, was scarcely begun owing to difficulties deriving from the lack of an electromechanical industry, so that in 1930 existed in the USSR territory only 100 km. of electrified lines, namely:

- 33 km. of the Baku-Sabutski line, with a 2.000 V. continuous current (1);
- 70 km. in the Moscow outskirts, with a 1.500 V. continuous current.

Within 1932 - end of the first five-year plan which in the field of electrical traction aimed to improve the original plan of 1921 - they succeeded only to end a section of 63 km. of the Transcaucasian line, between Stalinisk and Zestofoni through the Suram hill. This realization was however important because the experiment of exploiting a 3.000 V. continuous current gave very good results and induced to use this type of current for all the new lines to be electrified, besides the already existing lines which were to be completed.

From 1932, where it was possibile to exploit water power, they tried to apply the electric traction to all the lines which

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(1) To put in service this line the permanent material was imported from Germany and America, while the traction equipment was imported from Austria.

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showed special difficulties from the profile or traffic standpoint.

During the second five-year plan, between 1932 and 1937, electrification underwent a development, but the works brought to a happy result were inferior than planned: 1.041 km. instead of the planned 5.000 km.

During this period:

- the following lines were electrified;
  - Dolginzevo - Nicopol -Saporosie (182 km.)
  - Dniepropetrovsk - Dnieprodzerzhinsk (40 km.)
  - Kizel - Ciurovskaia (in the Ural Mountains) and other line sections north of Sverdlovsk
  - the lines of the Moscow and Leningrad outskirts were continued;
  - the electrification of the Murmansk-Sorokskaia line was begun.

The rolling stock was almost entirely imported from America, Italy, England and Austria and only some 3.000 V. with continuous current locomotives were built in the Soviet factory of Kolomna.

In order to limit importations, the Soviet authorities began in that period to build up a big factory for locomotives and electric locomotives at Kashira.

The reorganization of the railway traffic accomplished at the end of the second five-year plan showed that the electric traction was more advantageous, so an impulsion was given to the electrification of great traffic lines. In the meanwhile, new studies and experiments were begun for the use of high voltage single-phase current.

On the beginning of 1940, the total development of electrified lines was of 2.320 km., of which 406 km. of suburban lines.

During the war, all the works underway were discontinued, excepting those on the Moscow-Setun line.

On the other side, with the German invasion all the occupied territories installations were destroyed and the railway network at the end of 1941 was so reduced to only 1.323 km.; but at the end of 1946 it was again of 2.038 km.

The fourth five-year plan allocated to electric traction 2,5 milliards of roubles, by which they had to rebuild the destroyed installations and to equip 5.325 km. of new lines in order to reach a development of electrified lines of 7.363 km.

The programme planned, besides the repair of the destroyed lines:

- the continuation of works on the lines of Moscow and Leningrad suburbs;
- the extension of some already electrified lines (for instance the Caucasus ones);
- the electrification of the Transiberian between Ufa and Novosibirsk, besides that of the lines:
  - Sverdlovsk - Celiabinsk - Kartali -Magnitogorsk
  - Kartali - Akmolinsk - Karaganda
  - the northern part of the Vorkuta arctic line.

This programme was however revised and everything lets us suppose that it has been realized only in a small part.

According to unconfirmed information, the condition of the electrified lines or in course of being electrified were at present the following:

- the lines of annexed territories have been rebuilt, including a part of those of the Tallin area;
- the following branch lines have been electrified:
  - Sampredia - Sukumi, of the Transcaucasian line (161 km.)
  - Dioma - Ufa - Kurgan, of the Transiberian line (747 km.)
  - Akmolinsk - Karaganda (95 km.)
  - Novosibirsk - Novo Kuznetsk (449 km.)
  - Koshva - Vorkuta (459 km.)
- on the following branch lines works are underway:
  - Kurgan - Novosibirsk (1.168 km.)
  - Sverdlovsk- Celiabinsk-Kartali-Magnitogorsk (667 km.)
  - Kartali - Akmolinsk (805 km.)
  - Tuapse - Sukumi (219 km.)

Upon the whole, there were in service 5.430 km. of lines (See Annex n. 13) and 2.859 km. of lines under construction.

2. - Characteristics of electrifications.-

A - Power.- The first electrified lines having a considerable development (Moscow, Caucasus) exploit the power of a rather high number of hydroelectric and thermoelectric plants of low power.

Afterwards, for the Donbas and Krivoi Rog networks, they preferred to concentrate the production of power in high power hydroelectric plants, and a similar trend is at present followed. For the Transiberian line electrification it is in fact planned the construction of big hydroelectric power plants on the Volga, at Kuibishev, and on the Siberian rivers. But while waiting the end of these works, thermoelectric power plants having a power

of 50 up to 100.000 KW have been built and they are connected through a line of 110 KW. Of these power plants those of Novosibirsk, Omsk and Petropavlosk are knwon and they will be afterwards connected to the new hydroelectric power plants under construction respectively on the Ob, Irtich and Ikim rivers.

As combustible of the thermoelectrical power plants they use peat, brown coal, shale oil and coals which if gassified cannot be exploited in the same deposits.

B - Types of electric power used - Nearly all the known types of power suitable for electric traction have been tested and during a certain period the 3.000 V. continuous current has been preferred.

It is not however known, specially after the last experiments with single-phase alternate current, which will be the definitive choice.

a)- The continuous current at 550 - 570 V is used in some industrial and mining lines of the Ural Mountains and Siberia, with a development of 335 km. On these lines circulate about 200 electric locomotives, 70 of which were imported before 1937.

b)- The continuous current at 2.000 V is used only on the 72 km. of the Baku -Sabutski line, on which circulate 5 electric locomotives and 25 three-car electric trains.

c)- The 1500 V. continuous current was used in the Leningrad, Moscow and Tallin suburbs on 250 km. of line. During the fourth five-year plan, these railway networks would have been transformed into 3.000 V. continuous current. The Moscow railway network would have to-day a development of 600 km. and would have 650 two or three-car

electric trains, almost all newly built.

d)- The 3.000 V. continuous current is the one used till to-day on the main lines and according to the fourth year-plan it ought to have a total development of 4.500 km.

Technical details concerning the equipment of these lines are shown in Annex n. 14.

e)- The single-phase alternate current at 15 KV and 16 2/3 Hz is at present tested along the most northern branch of the Vorkuta line. Material used for the construction of this line would come partly from the German lines of Leipzig - Magdeburg and Saalfeld - Halle.

f)- The single-phase alternate current at 20 KV and 50 Hz is at present tested along 50 km. of the Moscow - Torbino line.For this line 4 electric locomitives have been expressly built. derived from the most recent Soviet series of the C.C. type with a 3.000 V continuous current and the addition either of a polyanodic rectifier or of ignitron (1). It seems they wish to use this type of current on the Kartali-Magnitogorsk line.

3. - Traction equipment.-

A - Electric locomotives for 3.00 V c.c. lines (See Annex n. 15).- For velocities lower than 85 - 95 km/h ,electric locomitives of C.C. type are used. These Soviet-made electric locomotives, that is to say those of V.L. and S.K. series, derive respectively

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(1) Mercury arc rectifiers.

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from the electric locomotives of S.S. series supplied by the General Electric (1) and from the electric locomotives of the S.I. series supplied by the Italian Tecnomasio "Brown-Boveri" (2).

For velocities higher than 115 - 130 km/h, electric locomotives built after 1935 and of the 2C2 type are used. In fact, electric locomotives of this type are those of the P.B.21 series, which is very similar to the Italian 326 series, able to haul trains of 700 tons on switchbacks of 10°/°° at a speed of 40 km/h or trains of 400 tons in the plain at 110 km/h.

All the Soviet made machines V.L. 19 and P.B. 21 have the same motors, bilateral transmission shaft and electropneumatic equipment. All have elastic gears (excepting those of the P.B.21 series, which have a Wastinghouse apparatus A.E.G.).

With the extension of the electric traction and the increase of the trains weight, the electric locomotives of the VL 19 and 21 series and S.K.22, which all can bear a traction stress of 20 tons per hour, showed themselves scarcely powerful for simple traction and too powerful for double traction. It was consequently necessary to build new , more powerful electric locomotives and so appeared those of V.L. 22 and 23 and S.K. 23 series: the former able to bear a traction stress of 28 tons and the latter of 23 t. Among two V.L.19 electric locomotives and a V.L.22 one there was a difference of 12 tons, which was considered too high. It was then devised and built a new eight-axle electric locomotive of the 2 DD2 type, having a power of 5.500 HP, able to bear a traction stress of 33 tons and which can be used either for goods trains or fast passenger trains.

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(1) 8 complete electric locomotives and the equipment to build 20 more.

(2) 7 electric locomotives.

All the electric trains of V.L.23, S.K.23 series and 2 DD2 type, as they have a weight per axle higher than 22 tons, cannot circulate on lines having a heavy permanent way (with rails weighing more than kg.38 per metre) and bridges devised for similar weights.

Lately, a heavy electric locomotive of the BB+BB type has been built, which derives from the already existing diesel-electric TE-20 locomotive of 2.000 HP, which power would be of 5.400 HP and its top speed of 160 km/h.

As for speed, it seems that the late electric locomotives of the CC and BB types can all develop a speed equal to the P.B.21 one.

Another feature of the late electric locomotives would be the existence of a gear variation which permits to use polyanodic rectifiers or ignitron so to be eventually used also with single-phase current at 50 Hz.

Type CC electric locomotives were also studied with the possibility to be feeded either by pantograph or through a diesel-electric set.

B - Electric locomotives for single-phase alternate current at 20 KV and 50 Hz. Two prototypes of the C.C. type, V.L.22 series were built.

These electric locomotives were supplied one with a polyanodic rectifier, and the other with ignitron. As both have kept the apparatus and motors of the types of normal series, they can circulate also on lines with continuous current at 1.500 V, or at 3.000 V.

4. - Considerations.-

The interest the Soviet Government has in the development of electric traction is not owed to the convenience to save other sources of power, but rather to:

- the necessity to increase the efficiency of the lines in the sections where traffic is most intense, so postponing to a future date the construction of redoubling;
- the advantages the electric traction has over the other types of traction on the mountainous areas and where very low temperatures are attained.

In spite of the efforts made during the last twenty years, all the devised plans for electrification have shown themselves too much optimistic with regard to the effective capabilities of Soviet industry in the field of electrical and electromechanical constructions; so that in practice all the realizations have been inferior than expected and the last five-year plan too has been executed only in a small part.

It is however to be noted that in the last five years have been electrified lines having a longitudinal development of about 4.000 km., that is to say nearly the double with regard to those electrified till 1940. This shows how the Soviet industry, though it has not reached the expected speed of development, has however done some progress.

What has been till now carried out can be summed up as follows:

- 5.430 km. of lines in service and about 3.000 under construction, most of them concerning: great traffic lines, suburbs of big industrial centres, mountainous zones, areas where the low local temperatures prevent a good efficiency of the steam engines, mining zones;

- foreign traction equipment or most of it built on foreign patterns, generally good and lately built;
- the most known types of power have been tested and till now the preference is for the 3.000 V. continuous current;
- it is not known whether, after the last trials with high tension (20.000 KV) single-phase alternate current, the former trend will be kept or, as it seems likely, this type of current will be preferred.

It seems consequently that we can conclude that:

- something has been carried out, though less than expected from the quantity standpoint;
- the development of Soviet specialized industry in this field will allow to increase in the future the number of electrified lines.-

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VII - ORGANIZATION -

The organization of the railway network and railway traffic is under supervision of the Ministry for Communication Routes, at present headed by Besdteev Boris, while the construction of rolling stock depends upon the Ministry for Transport Engines Constructions, at present headed by Maksarev Juria.

The Soviet railway network is subdivided among 10 Railway Sections each of which includes a number of departments. The departments include local railway networks and principal lines or sections of principal lines.

Sections and Departments have a name deriving from the region or the principal town they serve or from the name given to a line they cover.

On the basis of Soviet official documents, sections and departments have been located and they are shown in Annex n. 16.

The personnel employed in the Soviet railways would amount to about 1.500.000.-

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VIII - TRAFFIC -

1 - Goods traffic.-

A - Prewar period.- As we have seen, the Soviet regime during the first years, as regards railways, was anxious only to rebuild what had been destroyed during World War I and the civil war. He faced so the rapid industrialization of the country with a railway system which resulted nearly equal to the Czarist one.

On the beginning this system met the traffic requirements showing to be able to bear a developing traffic without any need of a corresponding increase of the existing equipment.

Trusting the intiial success, the Soviet Government's bodies persisted in limiting means, materials and manpower for railways preferring to help industries.

This fact caused an increased transport demand, which was by far higher than the increased traffic capabilities with the result that, though the railway traffic increased by 80% from 1928 up to 1932, at the end of this year 20 millions of tons of not forwarded goods stopped in the stations.

This crisis, which damaged the development of the economic plans, worried the Government who tried to stimulate the traffic increase but without increasing enough the necessary means. In spite of the reached improvement, at the end of 1934 the quantity of not forwarded goods amounted still to about 15 millions of tons.

It was only in 1935 that the Soviet Government decided to allot to railways the required materials and manpower. Kaganovich was appointed as head of the reorganized Commissariat for Railways, he tried to find out the solution of the crisis by concentrating

all the means he had at his disposal on a little number of principal lines, which he improved at the utmost degree and along them was set going the traffic of raw materials upon which the industrialization programme depended. Within 1937 the crisis was overcome.

According to Soviet sources the following were favourable factors:

- the already mentioned improvement of some main lines connecting the greatest centres and industrial areas;

- the putting in service of four-axle goods cars having a great carrying capacity;

- the tendence to let more and more heavy trains circulate, even to the detriment of velocity.

The ever increasing request of transportations and the fact that it would be difficult and expensive to continue the improvement of the railway system on the sole basis of the trends followed till then were one of the reasons which in 1939 induced to study and to carry into effect a new economical policy founded on the theory of the industrial localization.

By this theory the importance of the regions' self-sufficiency was stressed and a reduction of the exchanges of goods among very far regions was ordered, so compelling the concerns to look for the necessary supplies among nearer sources.

The carrying out of these leading principles, while permitting a reduction of the average transportation way, since 1940 brought to a transportation reduction of about 80-90 milliards t/km., which the increased volume of goods to be transported drew advantage from.

B - War period -

The German occupation reduced during the first year of war the length of the lines used by the Soviet to about 60% with regard to the one they disposed of in 1940; but it did not reduce proportionately the rolling stock they could evacuate.

Consequently, on the available lines, the proportion of locomotives and wagons was higher than the prewar one.

This fact allowed the Soviet railways, relieved at the utmost degree of the civil traffic, to bear easily enough besides the military traffic also the one concerning the operations of evacuating people and industrial equipments from the invaded or threatened countries. In the second half of 1941 these evacuation transportations absorbed about 7.000 cars daily, i.e. the same traffic volume which in the same period was employed for shipments of purely military character.

A characteristic of war years is the increased average length of transportations (from 700 km. in 1940 to 851 of 1943) owed to the increased traffic with the East. It must be taken into consideration that the Ural industries had to be supplied from the far Kuzbas with the materials before they received from the nearer Donbas.

The examination of the data concerning the traffic during the war period (See Annex n. 16) shows also, in opposition to what on the beginning can be presumed, how the traffic intensity (tons of goods divided for km. of line) decreased while war continued. This can be explained by considering that, both on the peripheric lines not having a particular military character or concerning the war constructions and on the ones which were repaired while the territories were reconquered, the prewar traf-

fic of civil nature practically ceased.

All the war effort for transportations, concentrated on a comparatively small number of lines, does not appear from the data showed in the Annex n. 17.

To get an idea rough enough we show the data about the daily average of the cars (1) loaded with war materials and troops between 1941 and 1945 and the relative percentage in comparison with the total of the loaded cars:

	1941	1942	1943	1944	1945
Cars loaded with war materials (daily average)	7.100 (2)	12.100	13.500	16.9000	17.100 (3)
% in comparison with the total of loaded cars		8,4	29,7	30,5	

Upon the whole, during the 47 months of war, the number of the loaded cars with war materials and troops was higher than 19 millions.

We don't dispose of the official data of the war period concerning the average time of the cars repair and the daily average of the employed cars, i.e. of those which can give a better idea about the use of the available means.

By inductively drawing up them, we obtain (with enough accuracy at least for 1952) those shown in the Annex n. 17.

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(1) Conventional two-axle cars.

(2) Average for the second half-year 1941.

(3) Average for the first five months of 1945.

The examination of these data allows us to explain how with a railway network reduced to 60% in comparison with that of 1940 but having:

- a greater density of rolling stock;
- a higher load for each car;
- an enormously increased requirement of transportations owed to military needs;

the railways succeded to transport goods for a total which in 1942 was the 46% that of 1940 if expressed in tons and 54% if expressed in tons per km.

In fact, we observe that in that year to an increase of 17,7% of the average transportation length corresponded an increase of 83% of the average repair time i.e. an increase which, owing to its entity, can't be entirely ascribed to the increased length of transportations.

It is difficult to assess which other causes influenced and in what intensity they influenced this fact. It may be presumed that we must look for among the following:

- necessity of keeping in the parks, at the disposal of the military authorities, for military operations, high percentages of cars;
- long unloaded return runs;
- loss of time during the operations of loading and unloading;
- poor equipped and badly organized shunting stations;
- inadequate flexibility of an organization accustomed to function according to traffic plans and systems studied and assimilated since long time.

The fact that the average time of the cars repair after stopping during the whole 1943 around a figure roughly equivalent

- average transportation length from 794 km. to 690;
- goods movement from 315 milliards of t/km. to 532;
- average time of cars repair from 10,9 days to 7.

These aims, together with those concerning the new railway constructions, show how after the war the leading principles were resumed which during the period immediately before the war governed the economical development of the country and the one of its railway system.

In fact, they show that, while they tried to adapt the transportation development to the one of economy, they persisted:

- in the theory of the industrial localization (reduction of the average length of distances);
- in improving the main lines (rebuilding and building up of new lines);
- in increasing the average load of the cars and the weight of the trains (new constructions of cars having a great carrying capacity and of high power locomotives).

Which were the results attained in 1950 is shown by the data contained in the Annex n. 1 (1).

It is to be noted:

a)- the transported goods exceeded the foreseen plans of 50 millions of tons i.e. of 6,48%, If true, it would show that the Soviet economy had a development more rapid than foreseen in 1946 and the railways were able to follow this development at least to an increase limit of 6,48%.

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(1) Data either direcly drawn up or through calculations of official information from Soviet source and consequently of doubtful reliability.

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b) The planned reduction of the average length of transportations were not fully attained as it resulted 6,08% higher than estimated. This result indicates that the regional economy resisted to the Government's will, which tried and is still trying to push it towards a higher degree of autonomy. It is however to be taken into account that the average length of transportations was negatively influenced - as far as their reduction is concerned - by another Governmental leading principle: the one recommending that transportations on short distances, specially in the mining zones, be transferred from railways to motor vehicles.

Now, it is known that during the five-year plan the automotive traffic increased so that the progress in this field made it more difficult for railways to reach the fixed aims. According to a rough calculation for 1949, without the increase of the automotive traffic, the average length of railway transportations would have been, in that year, of 715 km. instead of 737.

c) The traffic of goods was higher than foreseen of 69 milliards of tons per km., i.e. of 12,95%. This fact is a consequence of the higher quantity of transported goods and of the longer distances covered.

d) As for the average time of cars repair, the official report of the Soviet Central Office of Statistics does not give any data, but limits itself to make it known that, though it is considerably low compared with 1945, it has not reached the fixed limit.

According to the study shown in Annex n. 18, we can calculate that in 1950 this average time would be around 7,7 days, so being higher of 4,45% than the one of 1940. As we have tried to explain in the Annex n. 20, the increase would be owed not only to the con-

temporary increase of the average length of transportations, but also to the getting worse of the stopping times in the shunting stations and to the getting worse of times among stations of unloading and new loading.

This getting worse of stopping times in the shunting and traffic stations indicates that the service organization has become worse compared with 1949, and this is likely to be attributed to the following facts:

- the rebuilding of stations in West Russia is not yet completely accomplished;
- the equipment of railheads has generally made no progress compared with the traffic intensity;
- longer unloaded runs are perhaps effectuated.

e) The average load for each car (conventional two-axle units) would have reached 18,91 tons and this fact would imply an increase of 13,9% compared with 1940 and of 2,96% compared with the plan. This increase is explained by the putting in service of the new cars having a great carrying capacity and by a more rational exploitation of those in service. About the latter point, it must be taken into account that in 1937 too, the Soviet railways presented the peculiarity to be able to bear an average load per axle very high (5,6 tons compared with 3,7 in Germany and 3,9 in Italy) owing to the fact that in the Soviet Union nearly all the shipments are made with full loaded cars and very few are the shipments of single packages. So it is evident that the shipments of single packages have been further reduced.

f) From the comparison between the data concerning the daily average of the cars in service and those concerning the consistence

of the cars park (See Annex n. 19) we can see that the percentage of the immobilized cars for repair or other reasons is higher in 1950 (21,8%) than in 1940 (19,3%). As for this fact, it is to be initially observed that in 1946 the Soviet Government foresaw a daily average for 1950 of 800.000 cars in service, while they knew that they would be able to rely, with the new production and by keeping in service all the cars existing in 1946, on a park of 1.315.000 cars. Now, as it is not to be presumed that they calculated to keep more than 500.000 cars immobilized, we are induced to think that it was a part of the Soviet plan concerning the renewal of the rolling stock to eliminate about 200.000 cars built before 1917, and to eliminate a part of those more recently built but more deteriorated.

The fact that in 1950 the daily average of the cars in service exceeded 900.000 lets us clearly suppose that the Soviet Government suspended the planned elimination of the old built cars.

However, we don't have any information about what really happened and the data concerning the consistence of the cars park assume a purely indicative importance which can't be a basis of comparison.

Then it follows that nothing can be said as the reliability about the percentage of immobilized cars, excepting that this percentage is by far higher than in 1940.

g) The efficiency of the cars in service, ton-km. per car yearly, would have exceeded in 1950 of 13,9% the one of 1940. And this fact is a consequence:

- of the increased average of the carrying capacity of cars;
- of the increased average distance of transportations;

and in spite the average time of repair it increased in a proportion higher than the increased transportation distance.

2 - Passenger traffic.-

A - The passenger traffic along the Soviet lines has always had the characteristic to be modest and to be represented, most of it, by short distances. This in consequence of the existing police regime and of the Soviet economical policy which allow the citizens to go by train only for work reasons, serious family reasons or evidenced health reasons.

In 1940, for instance, the 75% of passengers and 25% of the whole traffic, expressed in km-passengers, were represented by suburban displacements of workmen who daily went and came back from work.

The data concerning the passenger traffic since 1940, according to official Soviet sources, are as follows:

	1940	1945	1946	1947	1950 (1)
Passenger-km. (milliards)	98	66,2	97,8	95,1	98
Number of passengers (milliards)	1,34	0,84	1,09	---	1,35
Km.per passenger (km.)	73	78,06	89,3	---	72,6

The same sources have generally disclosed that in 1948 the passenger traffic (passenger-km.)had decreased in comparison with 1947 and that in 1949 had begun to increase again reaching and exceeding the standard fixed for 1950.

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(1) Previsions of the fourth five-year plan.-

From the examination of these figures we draw the following considerations:

- the Government's policy would tend to keep unchanged the railway passenger traffic in spite of the increased extension of the controlled territory and of the constant population's increase; this fact confirms the tendency to transfer the passenger traffic from railways to the automotive lines and waterways for short distances and to airlines for great ones;
- the passenger traffic really tends to keep itself stationary, so letting to be supposed that its natural increase has been canalized - according to the Government's will - towards other ways.

B - From the examination of the time-tables for passenger trains of 1949 and 1950, we note that:

- the speed per hour of passenger trains on the great lines, very low in comparison with those of the great European and American lines, during 1949 has generally slightly increased, always exceeding now the 30 km. per hour and presenting in some cases a top speed higher than 50 km. only on the great meridian line Leningrad-Moscow-Kharkov-Rostov (See Annex n. 20); this fact, while explaining how it is that people having to cover great distances can easily prefer airplanes to trains, confirms the improvement of the railway system;
- except along the foresaid meridian line, the couples of trains which daily connect great and far centres, do not exceed the number of three and often it is only one (See Annex n. 20). This fact confirms the limited number of travellers along great distances;

- the tendency to canalize the traffic, specially the one bound beyond the Urals, along lines which are not always the shortest; this perhaps owing also to the fact that the shortest lines are reserved to goods traffic.

3 - Considerations.-

What has been said about the goods and passenger traffic can be summarized as follows:

A - During the last war, the Soviet railway lines:

- were able to meet war requirements only to the detriment of civil needs, reduced beyond any limit of normal endurance, and because in consequence of the initial German invasion, they could exploit a density of rolling stock higher than the peacetime one;
- specially during the first two years, they have considerably decreased their efficiency owing not only to war reasons, but also to the deficient equipment of stations and to the poor flexibility in the service organization.

B - After the war:

- Soviet railways could follow the development of Soviet economy even when the latter increased more rapidly than foreseen; to attain this result they had to delay, against what it was likely the Soviet authorities had in mind, the elimination of the more obsolete rolling stock;
- the tendence was increased to transfer:
  - the passenger traffic from railways to automotive lines and waterways on short distances, and to airlines along great ones;

- the goods traffic from railways to motor vehicles on short distances and to waterways along great ones;
- though giving a new impulse to the economic policy of industrial localization, they have not yet come back to the standard of 1940 and this owing to the fact that the reconstruction of stations in West Russia is still to be ended and that the equipment of shunting stations has not been improved in accordance with the traffic development;
- it seems that the causes which were a consequence of the war and could have a negative influence over the preservation of cars have been partially eliminated;
- the efficiency of railways were increasing owing to the greater number of cars having a great carrying capacity and to a more rational organization of transportations (a greater number of full loaded cars);
- the mean velocity, owing to the improvement of the lines and to the new traction equipment, has increased and as far as the passenger trains are concerned, it has exceeded the 30 km/h, so reaching 42 km/h in the Transiberian line and 54 km/h along the Leningrad-Moscow-Rostov line.

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IX - VULNERABILITY -

1.- General.-

The full examination of the Soviet railway network in order to seek the vulnerability, supposes the analytic study of railway junctions, permanent works, developed power of each line, type of traction used, etc.

This study will be done when we shall have the necessary information; for the time being we purpose to examine the problem from a general standpoint.

The Soviet territory stretching itself prevailingly like a plain, its form and extension, the great inland waterways which flow through it, the nature of ground, the aspect of the railway network looking like a cob-web in its European part and like a lengthened reticle in its western part, the type of the gauge used, while producing the impression to be difficult to put in crisis such a railway network, they show that the big bridges over the great rivers and the border trans-shipment stations are the most sensitive points.

The localization of such most sensitive points derives, as far as they concern:

- the bridges over the great rivers, from the combined study of the river and railway system;
- the trans-shipment stations, from the knowledge of localities where the Soviet gauge is replaced by the standard one and of the installations and devices used for trans-shipment.

The relative importance of such sensitive points and the choice of them as targets depend on the contrary upon the developed power of the concerned lines and upon the particular aims we wish to reach.

From a summary examination of all these elements it is to be observed that:

- the fluvial system, while covering like a reticle all the territory, is generally set, as far as the course of the great rivers is concerned, in the direction of meridians;
- the railway network, owing to the direction of the most part of the territory, is generally set in the direction of parallels;
- the lines of greatest developed power, by following the general course of the railway network, are also set in direction of parallels;
- the trans-shipment stations exist only in correspondence of western borders.

It follows that, whatever the aims we wish to reach might be, in a general way:

- it is nearly always possible to localize on each railway line one or more bridges where an adequate destructive action can provoke a considerable interruption of the traffic;
- the most vulnerable lines are those connecting East to West and which contemporaneously:
  - develop the greatest traffic;
  - in case of war at the western border would see this traffic still increased;
  - practically, they don't receive any help from the inland waterway network;

- the lines of most difficult vulnerability are those running along the meridians, that is to say those which:
  - connect the great industrial zones having the same longitude;
  - bring to northern borders and to the Middle East;
  - receive a great help from the inland waterways.

The following detailed examination aims only to indicate, in a rough way and without some specifications concerning the characteristics of the targets, the most sensitive points of:

- the lines leading to:
  - the northern border;
  - the north-western border;
  - the south-western border;
  - the Caucasian border;
- the lines connecting the European zone to the Asiatic one.

2 - Sensitive points of the lines leading to northern borders (1).

A - Bridges.-

The most sensitive points of the railway lines leading to the borders with Finland and Norway are mostly along two fluvial alignments:

a) Neva, the Ladoga lake, the Stalin canal;

b) Volga and Onega river.

The first cuts all the three independent lines leading to borders, respectively at Leningrad, north-east of the Lodomoie Polie station and at Sorokskaia.

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(1) See graph A1.-

The second cuts all the lines coming from the Moscow region and from the Ural Mountains at Kalinin, Volga, Iaroslav and Onega.

The branch line which from Sorokskaia leads to Murmansk presents also good possibilities of interruption: the bridges over the Kem river, the bridge immediately north of Louki and the one between Ruci Karelskie and Kandalaksha.

It must be pointed out the considerable importance of the only bridge on the Neva river at Leningrad in consequence of the three lines leading to the Finnish border south-west of the Ladoga lake.

B - Rail centres .-

Besides the Leningrad rail centre, which is scarcely vulnerable owing to its extension, the rail centres of Volkhovstroi and Obozerskaia must be signalized as important and sensitive ones.

3 - Sensitive points of the lines leading to the north-western border (between the Baltic Sea and the Carpathian Mountains)(1)

A - Bridges -

There exist 16 railway lines which cross the border with Poland and 6 - 7 independent lines coming from Central Russia which feed them.

Among the lines crossing this border:

- all the nine south of Volkovisk are vulnerable on the bridges over the Bug and the San;
- the seven north of Volkovisk are on the contrary easily vulnerable in the area between the Nieman river and the border.

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(1) See graph A1.-

However, the fluvial alignment Nieman - Bug - San cuts - excepting the Ternopol - Lvov - Sambor - Samok line - all the other lines in the following ten localities: Sovietsk, Kaunas, Grodno, Mosti, west of Baronovici, Cieremka, Brest, west of Kovel, Grudeshuv, Przem.

West of this alignment another one can be localized: that formed by the Dvina, Dnieper rivers and their tributaries, which by their course represent an obstacle for all the lines leading to the north-western border. The crossing points are the following: Riga, Kruspils, Daugavpils, Polotsk, Vitebsk, Borisov, Orsha, Moghilev, Slobin, north-west and south-west of Kalinkovici, west of Ciernigov.

Between the above said alignments other sensitive points might be localized, among which the most important are those along the Minsk-Brest line in correspondence of the Nieman and the Shura (a tributary of the Pripet).

B- Rail centres -

As shunting stations of all the traffic with Poland, must be signalized as especially important targets the following railway centres, which are they too on two alignments:

- advanced alignment: Sovietsk, Kaunas, Grodno, Volkovisk, Kovel, Lvov, Ternopol;
- rear alignment: Pskov, Polotsk, Orsha, Osipovici, Kalinkovici, Ciernikov.

C - Trans-shipment areas -

The trans-shipment areas among the Soviet gauge lines and the lines with European gauge of Poland are not all known.

On the main lines that of Brest on the Radom-Deblin-Brest-Minsk and the one of Przem on the Cracow-Tarnow-Przewoedsk-Przem-Lvov have been localized.

4 - Sensitive points of the lines leading to the south-western border (from the Carpathian Mountains to the Black Sea)(1)

A - Bridges -

The system of railway lines leading to the borders with Czechoslovakia, Hungary and Roumania (2)passes near the border, and precisely in an area having an average width of 100 km., through two lines of obstacles:

- the Carpathian chain and the Prut river
- the Dniestr river.

The first of these lines is crossed by six railway lines (three cross the Carpathian Mountains and three the Prut).

The most sensitive points of the three railway lines crossing the Carpathian Mountains, specially after the recent works, are unknown.

The three bridges over the Prut, all very important, are those of Ciernovtsi, Ungheni and Reni. Between Prut, railhead of a Soviet line, and Zorleni, railhead of a Roumanian line, there does not exist any bridge.

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(1) See graph A1.-

(2) Two lines lead to Czechoslovakia;
One leads to Hungary;
Six lines lead to Roumania (they are practically 5 because two of them, immediately after the border line, flow together into a Roumanian line, the Valea-Sakva).

On the second line of obstacles, the one of the Dniestr, the seven railway lines crossing it use six important bridges: two north-east of Strii, that of Stefaneshti, that on the Oknitsa-Zhmerinka line, that on the Beltsi-Slobodka and that of Benderi.

The seventh bridge, that on the Sianki-Sambor line, were on the contrary less important and could be easily repaired because it is in the higher part of the river.

A third fluvial alignment representing an obstacle for the lines wich from Ukraine lead to west, can be localized on the rivers Dnieper-Southern Brug. This alignment, in the bridges of Kiev, Ciercassi, Podgorodnaia, Kolosovka, crosses all the railway lines bound to west, except a very important one: the Dniepropetrovsk-Koristovka-Fastov.

Eventual destructive actions on this line, concurrently with the action on the bridges supporting the other lines, were to be made on the Znamenka-Tsvetkovo branch line.

B- Rail centres -

In order to break up the railway traffic towards west the following alignments must be taken into account:

a) Sambor - Strii - Stefaneshti - Oknitsa - Ungheni - Benderi;

b) Kiev - Tsvetkovo - Pomoshnaia - Kolosovka.

C- Trans-shipment areas -

The trans-shipment areas localized are those:

- between Cernia pri Ciop, Slovenie Novo Mesto and Michalany in Czechoslovakia;
- between Slovenie Novo Mesto and Miskols in Hungary;
- Zahony in Hungary;

- Radautsi in Roumanja:
- between Jassi and Ungheri, and
- between Galaci and Reny astride the Roumanian border of the Prut.

5 - Sensitive points of the lines leading to the Caucasian border(1)

A - Bridges -

Only two lines pass through the Caucasus: the Mediterranean and the Caspian.

We don't have enough information to localize in these branch lines important bridges representing sensitive points.

North of Caucasus the two lines are fed by three independent lines along which sensitive points can be localized first on the alignment Kubail river and Terek river (the bridges of Kavzavskaia-Kotliarevskaia and Ciervlenaia) and then on the alignment Don - Volga (bridges of Rostov and Astrakhan).

While the three lines are vulnerable on the first alignment, only two are vulnerable on the second. The line Povorino - Stalin grad - Kuberle - Tikhoretskaia escapes. To break it off a continuous action on the bridge over the Manic (south-west of Kuberle) were to be made, because this bridge does not seem to have a great importance.

B - Railway centres -

As railway centres shunting all the traffic bound to the Turkish and Iranian borders the following are to be taken into account:

- Samtredi, Navtlunghi and Aliat south of Caucasus;
- Tikhoretskaia, Armavir and Gudermes north of Caucasus.

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(1) See graph A1 -

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6 - Sensitive points of the lines connecting Central Russia to the Ural Mountains and Siberia (1) -

Through the industrial improvement of the Ural area and of that of the Kuznetsk basin, a great importance the lines connecting these areas to Central Russia, and in consequence with the West, reached.

So, it will be of particular interest, in case of war, to reduce to the utmost degree their efficiency.

This result might be reached west of the Ural Mountains by acting on the bridges of the following fluvial alignments:

- Sev Dvina - Viatka - Volga;
- Kana - Bielaia - Ural.

Six bridges of the first alignment (Kotlas - Kotelnici - Zelenie Dol - Ulianovsk - Sizran - Saratov) and six on the second (Molotov - east of Agriz - Ufa - Orsk - Ckalov - Uralsk) serve all the lines bound to west. Of these bridges, the most important are those of Sizran (on the first alignment) and of Ufa (on the second alignment) serving the line of greatest capability (the Trans iberian).

However it must be noticed that the bridge of Sizran might be outflanked by the recently built line on the right bank of the Volga, between Sizran and Kuibishev. It was built in consequence of the works concerning the construction of the new, big dam of Kuibishev. The capability of this line is unknown.

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(1) See graph A1 -

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7 - Conclusions.-

The above detailed examination confirms what in a general way was initially said: all the lines of strategic importance present sensitive points. The breaking off of them would provoke a considerable obstacle for the traffic regularity.

As we have seen, these points generally correspond to the bridges over the great rivers, to railway centres and trans-shipment stations.

Owing to the characteristic of these targets it follows that to put in crisis the Soviet railway transportations it is necessary:

- to destroy the big bridges;
- to make massive and continuous actions on the critical railway centres and on the trans-shipment stations.

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X - DEVELOPMENTS FORESEEN BY THE FIFTH FIVE-YEAR PLAN (1951-1955)

1 - Premise -

The Soviet fifth five-year plan, made public during the 19^ Congress of USSR communist party (October 1952), gives some elements concerning the developments which the Soviet Government plans to give, within 1955, to the system of railway transportations. (See Annex n. 21).

These elements are vaguer and more incomplete than those of the preceding plans and consequently, the data which can be drawn about the situation of railways which they wish to reach at the end of 1955 are only for guidance.

By basing ourselves on what is known about the situation up to 1950 and on the elements concerning the fifth five-year plan, the situation of Soviet railways in 1955, according to the Soviet aspirations would roughly be as follows:

Total development of railway lines	km.	141.000
Double-track lines	km.	53.000
Lines having automatic block system or automatic signalling apparatus	km.	47.500
Lines having heavy permanent way or a recently renewed one	km.	95.000
Electrified lines	km.	26.900
Consistence of the traction equipment park	n.	40.000
Consistence of the park of two-axle goods cars	n.	430.000
Consistence of the park of four-axle goods cars	n.	860.000
Consistence of the passenger cars park	n.	42.000

Goods transported in the year (millions of tons)		1150 up to 1190
Average length of transportations	km. ? (1)	< 725
Goods movement in the year	milliards of tons per km.	810 to 840
Average time of cars repair	days	6.3
Average load per car	tons ?	> 19
Passengers transported	millions	1.350

As comment and supplement it can be observed the following:

2 - Railway lines -

The five-year plan would foresee:

- new constructions for a total of about 18.000 km. of lines, but it does not specify that someones, i.e. (2):
  - the Abakan - Akmolinsk, nearly all built except in the section Abakan - Stalinsk;
  - Kungrad - Makat and the
  - Guriev -Astrakhan, which with the Ciardzhou - Kungrad (nearly all completed) and the Makat - Guriev (in service since many years), will connect the Turkestan to Central Russia through a line which will be a redoubling of the already existing Aris - Kandagash;
  - Krasnoiarsk - Ienisseisk in Central Siberia;
  - Agriz - Pronino - Surgut which together with the already existing sections will represent a new feeder line among the four lines connecting the Ural Mountains to Russia.

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(1) It is likely to amount to 700 km.

(2) See also Graphs C1 and C2.-

It is not to be excluded that among the lines which are not mentioned are included:

- the new line which will connect the Turkestan, through the Singkiang, to the railway network of north-western China;
- some sections, not well specified, planned in the Far East;
- the redoubling of tracks for a total of about 20.000 kms. of lines; there is no indication to be able to localize which lines they plan to improve;
- installation of automatic block system and automatic signalling apparatus along non specified lines for a total which might be calculated around 26.500 kms. of line;
- renewal of non specified permanent way. On the basis of the rails at disposal of railways (85% more than those at disposal of the preceding plan) and taking into account the new constructions, we could roughly evaluate the development from 35 up to 45.0000 kms. of line;
- electrifications for a total of 21.500 kms. of lines, that is to say works corresponding to the triple of the lines existing in 1950.

We don't Have enough elements to assess whether this programme will be executed in the fixed time. We are doubtful about this possibility.

Greater reservations must be made as for the electrifications which are planned in a considerable quantity. If the Soviet industry of electric and electro-mechanical constructions will be really able to make such an effort we ought to think that in this field it is at the head of world industry, and it is not to be considered as possible.

3 - Traction equipment and rolling stock -

The five-year plan made public does not show any data either on new constructions or on the material they plan to replace. It limits itself to say that they will provide:

- to meet the requirements of traction and rolling stock;
- to begin the production of new powerful locomotives and Diesel locomotives with gas turbines;
- to supply the wagons which still do not have it with a system of automatic coupling.

It is consequently difficult to determine the park composition at the end of 1955.

The composition reported in par. 1 is only for guidance and it was set up by supposing that during 1951-1955:

- the capability reached by Soviet workshops at the end of 1950 will not change (1.800 locomotives, 80.000 four-axle goods cars, 2.000 passenger cars);
- about 1.000 old locomotives, 30.000 old two-axle cars and 15.000 old four-axle cars will be eliminated;
- they will eliminate as many passenger cars as they will be able to build new ones.

Such a composition of the park, which takes into account the leading priciples the Soviet Government till now followed about railway transportations, would let almost unchanged, with regard to 1950, the availability (1) of locomotives per km. of line (0,28 in 1955 in front of 0,26 in 1950), would let increase from 10,5

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(1) Evaluated in real units.

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up to 10,8 the availability (1) of goods cars per km. of line and would let unchanged, but would improve it from the qualitative standpoint, the total consistence of the passenger cars park.

4 - Traffic -

The five-year plan, while saying nothing about the passenger traffic - which consequently might be supposed unchanged - plans:

- an increase of goods transportation of 35% - 40% in comparison with 1950, i.e. an increase from 210 up to 240 milliards of tons-km.;
- a reduction of 18% of the average time of cars repair, i.e. of 1,4 days compared with the presumed 7,7 days of 1950. This fact would imply a reduction of the average length of transportation;
- an increase of 12% of the average daily run of locomotives and as we don't know the data to which to assign the increase, it would imply an unspecified increase in the efficiency of traction equipment;
- an unspecified but considerable increase of the average load per car;
- a further increase of the goods trains tonnage.

It follows that the complete execution of such plans would bring about:

- a reduction of the average length of transportation to at least 700 km. (this goal was not reached in the fourth five-year plan);
- an average increase of efficiency of the traction equipment from 26.054 up to 41.800 tons in a year on a km. (almost

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(1) Evaluated in conventional units of two-axle goods cars.-

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twice as much the one the French equipment had in 1946 and nearly two thirds of the American one in the same year).

5 - Considerations -

The leading principles the Soviet Governments give about the railway traffic of next years are unchanged compared with the preceding ones:

- development of the network in the East;
- general improvement of the network;
- great development of electrification;
- increase of the trains weight, of the average load per car, of the traction equipment capabilities;
- reduction of the average length of transportations;
- transfer from railways to other means (automotive means, airlines, waterways) of a percentage of transportations.

The goals they plan to reach would imply a considerable effort specially as the enlargement of the railway network, new electrifications and increase efficiency of the system are concerned.

There do not exist enough data to surely assess whether this will be realized, except as far as the electrifications are concerned. This would appear rather difficult, even if we consider that to eventual deficiencies of Soviet industry might make up for, and so is now the case, the industry of Satellite countries.

The complete carrying out of this programme plans to have:

- double tracks along more than a third of the whole network;
- renewed permanent way along near two thirds of the network;
- station tracks for a total length corresponding to nearly two thirds of the network;

- about the 55% of the traction equipment park formed by high power machines with less than 18 years (1);
- about the 65% of the goods cars park formed by four-axle cars having a great carrying capacity and a maximum of 27 years (2);
- an unpecified number of passenger cars, but certainly enough for the service on the great lines.

It is not easy to assess whether - owing to the planned traffic increase,(3) the improvements the lines will undergo and the improved composition of the rolling stock park, will let to Soviet railways a margin of unexploited power higher to the scarcely considerable one they have now.

It is however sure that to enable them to meet military requirements in wartime it will be necessary a reduction of transportations which are not indispensable, smaller than the one which would be necessary now.

Besides that, it will be considered as reduced, owing to the increased capabilities of the lines, the time necessary to permit great units and their supplies to flow to Western borders.

Generally, should the plan be carried out, in 1956 Soviet railways, though having characteristics quite different from the ones of Western countries, would become an instrument quite adequate to the economical needs of the country in peacetime and able to meet, without no difficulty, an eventual period of war emergency, but by reducing a great part of the transportations essential for civil population.

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(1) The 37% of total were to have less than 10 years.
(2) The 78% of them were to have less than 10 years.
(3) The traffic intensity in 1955 would be of about 8.290 tons per km. of line yearly, instead of the 6.674 of 1950.-

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A N N E X E S

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ANNEXES

Annex n. 1

REGIONAL RAILWAY NETWORKS (1)

NETWORKS	NOTES
Northern network	Ends in Konosha and is connected to Moscow through a double-track line: the Konosha-Jaroslav-Moscow line.
Leningrad and Karelian-Finnish network	Ends in Leningrad and is connected to Moscow by two railway lines: a double-track one, i.e. the Leningrad-Kalinin-Moscow, and a single-track one, the Leningrad-Sankovo-Moscow.
Baltic and north-western area network	It is connected to Moscow by: - a double-track line: Kaliningrad - Minsk-Smolensk-Moscow; - a single-track line: Riga-Resekne-Veliki Luki-Moscow.
Ukraine and south-western border area network	Ends in Kiev and is connected to Moscow by a partly double-track and partly single-track line: Kiev-Bakhmasc-Briansk-Moscow.
Donbas network	Ends in Kharkov and is connected to Moscow by two double-track lines: -Kharkov-Orel-Tula-Moscow; -Debalzevo-Kupiansk-Valuiki-Eleci-Ozherelie-Moscow.

(1) What is said about the conditions of the lines concerns the first months of 1950.

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NETWORKS	NOTES
Caucasus network	Ends in Rostov and is connected to Moscow by a double-track line: Rostov-Millerovo-Liski-Riazan-Moscow
Moscow network	Ends in Moscow itself.
Volga network	It is not to be considered an independent network, but rather a transit one for the lines which from the Ural Mountains, Turkestan and Caspian Sea bring to Moscow, Donbas and Caucasus. As for the communications with Moscow, except the double-track line Gorki-Moscow and the single-track one Kazan-Kanash-Mirom-Moscow, it is backed by the foresaid Konosha-Iaroslav-Moscow and Rostov-Millerovo-Liski-Riazan-Moscow.
Ural Mountains network	It serves the Ural Mountains industrial area and is connected to the western regions by four independent lines: 1 - Sverdlovsk-Molotov-Kirov-Bui: this is a single-track line connected to the Konosha-Moscow at Vologda and Danilov; 2 - Sverdlovsk-Kazan-Kanash-Mirom-Moscow. This is a single-track line;

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NETWORKS	NOTES
	3 - Celiabinsk-Kinel-Kuibishev-Sizran: a double-track line and electrified till Dioma. From Sizran it continues till Moscow through the Sizran-Inza-Rusaievka (a partly double-track and partly single-track line) and Donbas through the double-track line Sizran-Penza-Povorino-Liski-Valuiki-Kupiansk-Debalzevo; 4 - Kandagash-Iletzk-Saratov (a single-track line). From Saratov it continues to Moscow through the double-track line Saratov-Tambov-Miciulinsk-Riazan, and towards Caucasus through the single-track line Saratov-Stalingrad-Salsk-Tikhorestskaia; 5 - the single-track line Orsk-Cikalov-Kinel, which joins itself to the Celiabinsk-Kuibishev at Kinel (41 km. from Kuibishev).
Turkestan network	It serves all the area south of the Aral and Balkash lakes, between the Caspian Sea and Altai Mountains. It is connected: - to the Ural Mountains network by a single-track line: Aris-Aralsk-Kandagash-Iletsk;

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NETWORKS	NOTES
	- to the Western Siberia network by two single-track lines: - Ciù-Mointi-Zharik-Karaganda (a new built line in its southern part) - The Turksib line: Alma Ata-Semipalatinsk-Barnaul.
Western Siberia network	It serves Siberia between the Ural Mountains and Baikal lake and specially the mining zone of Karaganda and the mining-industrial one of the Kuznetsk. It is connected to the Ural Mountains network by three lines: - the Transiberian (double-track): Taishet-Novosibisk-Omsk-Celiabinsk; - Omsk-Tiumen-Sverdlovsk (single-track); - Abakan-Novokuznetsk-Barnaul-Kulunda-Pavlodar-Akmolinsk-Kartali-Magnitogorsk (single-track and partly under construction).
Far East network	Essentially formed by the Transiberian: Taishet-Irkutsk-Cita-Skovorodino-Kabarovsk-Vladivostok. It is a double-track line, from which the following main lines branch: - from Ulan-Ude a single-track line towards Ulan-Bator, in Outer Mongolia;

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NETWORKS	NOTES
	.- from Cita a single-track line towards Manchuria; - from Karihishevka a single-track line towards Blagoveshevka and Manchuria - from Dezhevka a single-track line towards Konsomolsk; - from Voroshilov a single-track line towards Manchuria and Korea. It seems this network will have within 1960 another line which passing through the regions of the Transiberian, would practically represent a redoubling of this one from Taishet to Konsomolsk. As far as the route is concerned this new line will have to follow we have very conflicting information. The Soviet maps do not give any information. The new French ones present it as an already built line but disagree about the route. The same can be said about the German maps. In the graph C2 the most reliable route is reported. -o-o-o-o-o-o-o-

CONSTRUCTION OF TRACTION EQUIPMENT

YEAR	CONSTRUCTION (in real units) OF						
	ELECTRIC LOCOMOTIVES		DIESEL LOCOMOTIVES		LOCOMOTIVES		
					FD	I.S.	S.O.	Different types
1928	---		---					700 (1)
1929	---		---					700 (1)
1930	---		---					700 (1)
1931	---		---					700 (1)
1932	1 (2)		1 (2)					800 (2)
1933	?		?					
1934	19(2)		8 (2)					
1935	?	350(3)	?	248 (3)	2375 (3)	255 (3)		
1936	48(2)		13(2)		985(3)		-	5116 (3)
1937	?		?					
1938	?		?					
1939	?		?					
1940	?	350(5)	?	350(5)	1870 (4)	1500 (4)	3200 (4)	100 (4)
1941	?		?					
1942	?		?					
1943-45	?		?		?	?	?	?
1946	?		?		?			
1947	?		?		?			
1948	?	555(6)	?	865(6)	?	..... 6165 (6)		
1949	?		?		?			
1950	220(7)		300(7)		2200 (7)			

NOTES TO ANNEX n. 2

(1) In default of other data we have taken that (estimated) of the average increase of the park.

(2) Soviet official data.

(3) Prevision of the second five-year plan realized only for a total of 5960 locomotives (Soviet official data).

(4) Prevision of the third five-year plan, probably not fully realized.

(5) Estimate on the basis of the third five-year plan previsions, which planned 800 units among the different types F.D. - I.S. and S.O.

(6) Prevision of the fourth five-year plan (the type of the locomotives is not exactly determined).

(7) Output capacity on 1950 planned by the fourth five-year plan.

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NUMBER AND TYPES OF LOCOMOTIVES BUILT FROM 1928 (1)

Electric locomotives	1256
Diesel locomotives	1464
Locomotives FD	4245
Locomotives IS	1755
Locomotives SO	3200
Locomotives of not exactly determined modern type	6165
Locomotives of different types	8716
Total	26801

(1) The following data are partly drawn from the previsions of the five-year plans. The locomotives really built were less.

ANNEX n.3

CONSISTENCE OF THE TRACTION EQUIPMENT PARK (OF ALL TYPES)

At December 31 of each year	Consistence of the park in real units	Increase of the park in real units	Output in conventional units	Output in real units	Km. of lines	Relation n. locomotives / Km. of lines
1912	17.000 (1)					
1913	?	?	418 (1)	664(1)		
1927	15.100 (1)	?	?	?		
1928	15.800	700 (1)	?	?		
1929	16.500	700 (1)	?	?	74.000	0,21
1930	17.200	700 (1)	?	?		
1931	17.900	700 (1)	?	?		
1932	18.700	800 (2)	831 (2)	?		
1933	?	?)	?)	?)		
1934	?	?(3.400 (2)	(1)1.307)	?)		
1935	22.100	?)	?(7000(2)	?(5960(1)		
1936	23.000	900 (1)	(1)1.682)	?)		
1937	23.700	700 (1)	(1)1.583)	?)	86.000	0,27
1938	?	?)	(1)1.626)	?)		
1939	?	?)	?)	?)		
1940	?	? (6400(4)	? (11180	?(7370(3)	106.000	0,27
1941	30.100	?)	?) (3)	?)		
1942	24.000	6.100(5)	(3)2.090)	?)		
1943	?	?	?	?		
1944	?	?	?	?		
1945	?	?	?	?	113.000	?
1946	?	?))	?)	?)		
1947	?	?)	?)	?)		
1948	?	? (7585 (7)	? (11655	?(7585(6)		
1949	?	?)	?) (8)	?)		
1950	32.000(11)	2.720(7)	(10)4190	(9)2790	123.000	0,26

NOTES TO ANNEX n. 3

N.B. - In the underlined figures the locomotives of the industries are not included.

(1) Datum drawn from "Etude et Conjoncture" n. 7 and 8 of december 1946 and january 1947 and which report data from official Soviet source.

(2) Estimate.

(3) Prevision of the third five-year plan, excepting the locomotives for industry.

(4) Prevision of the third five-year plan, included the locomotives for industry.

(5) Losses owing to war (about 15% of the 1940 strength).

(6) Prevision of the fourth five-year plan, probably realized only within 1951.

(7) Taking into account the park's increase and considering it equal to constructions.

(8) The coefficient 1,5 is given to all the 6165 locomotives of the fourth five-year plan (See annex n.2). If we give them coefficient 1 by considering that among these 6165 locomotives can be included switching locomotives of low power, the result would be reduced to 8572.

(9) Prevision of the fourth five-year plan (See annex n. 2).

(10) Coefficient 1,5 is given to all the 2200 locomotives planned by the fourth five-year plan (See Annex n. 2). If we give coefficient 1 the datum would be 3090.

(11) This estimation is made by considering that through the results of the fourth five-year plan all the war losses were recovered and the goals of the third five-year plan reached.

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Annex n. 4

WORKSHOPS FOR CONSTRUCTION AND REPAIR OF TRACTION EQUIPMENT (1)

1.- "Kuibishev" workshop of Kolomna:	It is one of the most ancient and most important factory of locomotives, electric locomotives and Diesel locomotives.
2.- "October Revolution"workshop:	At Voroshilovgrad: it is too one of the most ancient plants; it was rebuilt after the war. In 1947 it was building locomotives of the S.S. and F.D. 2-7-2 types with a daily output of 1.
3.- Kharkov workshop	It is too one of the most ancient plants. In 1947 it was building electric locomotives of the "Te-1-20-001" type.
4.- Kashira workshop (Region of Moscow)	Specially equipped for electric locomotives construction.
5.- Kaluga workshop (Region of Moscow)	Specially equipped for small switching locomotives of 300-350 HP.
6.- Novocerkask workshop (Donbas)	Specially equipped for the construction of industrial narrowgauge locomotives. In 1949 it had an output of 4 locomotives per month.
7.- Bezhitsa workshop (NW of Briansk)	Completely rebuilt after the war. It builts high power locomotives for the Transiberian lines (probably of S.O. type with condenser tender) and low power locomotives. In 1949 the monthly output was of 10 locomotives.

(1) See also graphs B1 and B2. The running number corresponds to the graph's one.

8.- Gorki workshop.	
9.- Karaganda workshop (?)	
10.- Krasnoiarsk workshop	Built during the last five-year plan.
11.- "Mogerievsk" workshop of Moscow	In 1946 it was building electric locomotives of the S.S.C. 1-5-1 type.
12.- "Lenin" workshop of Rostov	In 1946 it was building wheels, axles and spare parts for S.O. locomotives.
13.- "Sageriesh" workshop of Kuibishev	In 1946 it was building locomotives of the S.S.C. 1-5-1 type.
14.- Orsk workshop	It was building locomotives and electric locomotives.
15.- Stalinsk workshop	
16.- Ulan-Ude workshop	
17.- Dzaudzhikau workshop (Caucasus)	Built after the war
18.- Mariupol workshop	Built after the war
19.- Batum workshop	For repair
20.- Kiev workshop	" "
21.- Novosibisk workshop	" "
22.- Omsk workshop	" "
23.- Riga workshop	" "
24.- Sverdlovsk workshop	" "
25.- Tiflis workshop	" "
26.-Ckalov workshop	" "
27.- Chita workshop	" "
28.- Dzhambul workshop (Turkestan)	" "
29.- Sarepta workshop	Builds and repairs locomotives
30.- Molotov workshop	

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GOODS CARS PARK

ANNEX n. 5

Year	Consistence of two-axle conventional units (1)	Yearly construction of goods cars: In conventional units		Two-Axle		Four-axle	Consistence in real units: In two-axle cars	In four-axle cars	TOTAL
1913	?	24.416 (1)		24.416(1)			?	?	?
1915	?	36.525 (1)		36.525(1)			2	?	?
1927	442.000(5)	7.951 (1)		7.951(1)			442.000(5)	(10) ?	442.000
1928	452.600(5)	10.600(3)		10.600(3)			452.600(5)	(10) ?	452.600
1929	?	?		?			?	?	?
1930	?	?	66.000	?	34130	17.190	?	?	?
1931	?	?	(4)	?	(7)	(7)	?	?	?
1932	508.000(2)	20.000(3)		10.600(3)			476.130(7)	17.190(7)	493.320
1933	?	?		?			?	?	?
1934	?	?	187.000	?	63000	67.000	?	?	?
1935	?	?	(6)	?	(8)	(8)	?	?	?
1936	?	68.000(6)		?			?	?	?
1937	695.000(9)	59.100(6)		?			539.130(9)	84.190(9)	623.320
1938	?	?					?	?	?
1939	?	?	330.000			178200	?	?	?
1940	?	?	(11)	None (11)		(11)	?	?	?
1941	959.000(12)	?					539.130(13)	226.790(12)	765.920
1942	765.000(14)	90.000(11)					430.000(14)	181.000(14)	611.000
1943	?	?					?	?	?
1944	?	?	78.000	None		42.000	?	?	?
1945	843.000(15)	?	(15)			(15)	430.000(13)	223.000(15)	653.000
1946	?	?					?	?	?
1947	?	?	472.500			255150	?	?	?
1948	?	?	(16)	None			?	?	?
1949	?	?					?	?	?
1950	1.315.500(17)	146.000 (17)					430.000(13)	478.170(17)	908.170 (17)

NOTES TO ANNEX n. 5

(0) 100 two-axle conventional units equal to 54 four-axle real units or to 100 two-axle real units.

(1) Great Soviet Encyclopaedia.

(2) Le Chemin de Fer en U.R.S.S. - Presse Universitaire de France - 1946 - page 31.

(3) Soviet official sources. Results of the first five-year plan.

(4) International press.

(5) Estimated datum by taking as not considerable the number of the four-axle cars.

(6) Results of the second five-year plan.

(7) Estimated by considering that the 66,5% of the real constructions of the first five-year plan had to be two-axle ones.

(8) Estimated by considering that the 48,5% of the real constructions of the second five-year plan had to be two-axle ones.

(9) Estimated by letting the increase correspond to the production.

(10) Unknown but however considerable.

(11) Previsions of the third five-year plan.

(12) Estimated according to the yearly average of the planned constructions of the third five-year plan (66.000).

(13) Considered unchanged.

(14) The losses of the first year of war are considered about the of the park.

(15) Datum drawn from the Annex n. 18 and considering the daily average of the cars in service amounting to the 80% of the park consistence.

(16) Increase of the park planned by the fourth five-year plan.

(17) Prevision of the fourth five-year plan probably realized only within 1951.-

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Annex n. 6

PASSENGER CARS PARK

Year	Consistence	Construction	
1913	30.300 (1)		
1915	?		1828 (2)
1925	24.900 (1)		
1926	?	726 (2)	
1928	?	?	
1929	?	?	
1930	?	?	4100 (8)
1931	?	?	
1932	29.000 (1)	?	
1933	?		
1934	?		
1935	?		5901 (1)
1936	?		
1937	34.900 (1)		
1938	?		
1939	?		
1940	?		12000 (3)
1941	44.500 (5)		
1942	35.600 (6)		
1946	?		
1947	?		
1948	?		6000 (4)
1949	?		
1950	41.600 (7)		

(1) Soviet official source (See: "Etude et Conjoncture"-Presse Universitaire de France).
(2) Great Soviet Encyclopaedia.
(3) Prevision of the third five-year plan.
(4) Prevision of the fourth five-year plan.
(5) Estimate. In this figure are also included the old passenger cars which probably the previsions of the third five-year plan for 1942 (23.500 cars) did not consider any more.
(6) Considering a loss of the 20% during the first year of war.
(7) Estimate (included at least 14.000 cars built before 1915).
(8) Estimate, considering the constructions corresponding to the park's increase.

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ANNEX n. 7

WORKSHOPS FOR THE CONSTRUCTION AND REPAIR OF RAILWAY WAGONS (1)

I	Bezhitsa (north-west of Briansk)	Completed during the second five-year plan; builds steel chassis and automatic brakes; much damaged during last war; completely rebuilt and equipped with modern machinery. It builds wagons and wheels for wagons.
II	Dniepropetrovsk	Builds wheels for wagons.
III	Dnieprodzerhinsk	Builds goods cars and wheels for wagons.
IV	Dzhaudzhikau	Builds and repairs wagons.
V	Gorki	Builds wagons and tank-wagons.
VI	Kadievka	Builds wagons.
VII	Kalinin	Built in the first years of 1900; enlarged and modernized recently too; it builds wagons.
VIII	Kaliningrad	Equipped to be able to build self-unloading wagons.
IX	Kazan	Builds wagons.
X	Kiev	There are two workshops and perhaps three, of which: - one in the neighbourhood of the Darnitza stations and builds goods cars of different types, and specially truck-cars; - one 7 km. far from Kiev on the road towards Nasoka; it repairs wagons; - one immediately out of the town along the Dnieper.
XI	Kremenciug	Builds wagons.
XII	Kuibishev	Builds wagons.
XIII	Leningrad	Builds wagons.

(1) See also graphs B1 and B2. The running number corresponds to the graph's one.

XIV	Izevsk	It were building wagons.
XV	Lwow	It builds goods wagons and passenger cars.
XVI	Mariupol	Builds tank-wagons.
XVII	Minsk	Repairs wagons.
XVIII	Mitisshi	It is one of the most ancient workshops; it builds wagons.
XIX	Nikolaev	It builds iron bridges and railway equipment of different kinds.
XX	Nizhi Taghil	It builds wagons.
XXI	Omsk	Repairs railway wagons.
XXII	Riga	Builds wagons.
XXIII	Rustavi	It builds railway equipment of different kinds.
XXIV	Saratov	It builds wagons and railway equipment of different kinds.
XXV	Stalinsk	It builds locomotives and railway wagons.
XXVI	Stalin	It builds railway equipment of different kinds.
XXVII	Stanislav	It repairs railway equipment.
XXVIII	Strii	It repairs rolling stock. In 1948 it transformed German goods cars into Soviet gauge cars.
XXIX	Tambov	It repairs wagons.
XXX	Ufa	It repairs railway equipment of different kinds.
XXXI	Uralsk	Built during the second five-year plan: it builds wagons and wheels.
XXXII	Uroc	It repairs wagons.
XXXIII	Zdanof	It builds tank-wagons.

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Annex n. 8

EXCERPT FROM THE FOURTH FIVE-YEAR PLAN AS FAR AS TRANSPORTATIONS ARE CONCERNED

In order to meet the increasing requirements of the national economy in the field of transportations, the following tasks were allotted:

to ensure to the railway transportations in 1950 an average load of 115.000 wagons and a goods movement of 533 milliards of tons-km;

to renew the railway transportations in those regions which were occupied by the Germans. To surpass the prewar standard as for the movement on the lines: Donbas-Moscow, Donbas-Krivoi Rog, Donbas-Along-the-Volga, on the roads coming from Caucasus: Moscow-Leningrad, Moscow-Lvov, Moscow-Smolensk-Minsk-Kaliningrad, Moscow-Veliki Luki-Riga;

to fully and uninterruptedly meet the transportation requirements of the Ural Mountains and Siberia industries;

to technically transform the railway roads on the main lines and to ensure the road conditions in winter first of all by electric and motor railways;

to complete the railway park with 6165 locomotives, 555 electric locomotives, 865 Diesel locomotives, 472.000 goods cars and 6000 passenger cars;

to supply the 93% of goods wagons with automatic brakes and the 75% of wagons with automatic "pufer". To repair the out of use cars and improve the repair of electric locomotives and wagons;

to speed up the movement of the wagons on the railway lines bringing it from the 10,9 days of 1945 to 7 in 1950, to reduce

the transportation distance of railway shipments from 790 km. to 690 km. in 1950. To reduce at maximum the stopping of wagons on the railway lines of the industrial enterprises;

to appropriate during the five years - for the works concerning railway transportations - 40,1 milliards of roubles;

to complete in 1948 the general restoration of rail-lines in the Donez mines and the Krivoi Rog mining basin, of the rail lines connecting Moscow with the Donbas, Leningrad and Caucasus on a total length of 15.000 km. To restore and build ex novo along the railway lines formerly in German hands, 1800 big and small bridges, among which those too on the rivers Dnieper, Don, Dniester, Neva, Nieman, Zapadna, Dvina, Volkhov, Juzni, Bug. To renew and build 1500 railway stations, 1300 roundhouses, 128 depots for wagons, workshops and repair;

to build during the five years new railway lines for a total of 7230 km., among which the Staliinsk-Magnitogorsk line;

to build and renew secondary tracks for a total amount of 12.500 km. To electrify 5325 km. of railway lines. To set up automatic signalling apparatus along 14.000 km. of railway lines;

to continue the works of development and technical supply of the railway stations and main centres, to build or renew 22 mechanized pointsmen;

to lay on the existing railway network 50.000 km. of new rails by which to rebuild 3000 km. of railway line and to make a general repair on 29.000 km. of railway line;

to renew the plants for repairing electric locomotives and wagons destroyed during the occupation and to build up 11 new plants for electromotors repair, 1 plant for wagons repair and 3 plants for the production of spare parts;

to ensure from 1945 up to 1950, 5,5 millions of square metres of room for the housing of railway transportations workmen;

to allocate to railway transportations from 1945 up to 1950 4,5 millions of tracks, 2 millions of sidetracks and 185 millions of sleepers and begin the construction and laying of heavy tracks;

to increase the mechanization of the railway transportation loading and unloading works by 75% with regard to the total amount of the works;

to ensure the restoration of local railways in the areas formerly occupied by the Germans, to rebuild the existing ones and to build new railway stations, especially those of the Ural Mountains and Siberia, and to improve the work of workshops for the transportations of industrial enterprises.

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Annex n. 9

DOUBLE TRACK LINES (1)

In service at the beginning of 1950:

Leningrad-Gatcna	Km.	47
Leningrad-Volkhovstroi	"	123
Leningrad-Viborg	"	130
Leningrad-Moscow	"	651
Leningrad-Pskov	"	276
Mga-Tosno-Gatcna	"	60
Moscow-Minsk	"	747
Minsk-Vilno-Kaliningrad	"	522
Minsk-Brest	"	349
Baranovic-Volkhovisk	"	126
Molodecno-Volkhovisk	"	238
Orel-Briansk-Gomel-Kalinkovici	"	549
Kursk-Konotop-Kiev-Zhmerinka-Lwow-Przem	"	1090
Kazatin-Rovnro-Brest	"	442
Shauliai-Radvilishkis	"	20
Moscow-Tula-Orel-Kharkov-Lozovaia-Nikitovka-Rostov	"	1351
Moscow-Ozherelie-Valuiki-Kupiansk-Debalzevo	"	966
Moscow-Riazan-Miciulinsk-Liski-Millerovo-Rostov-Armavir-Prokladnaia	"	1926
Lozovaia-Saporosie	"	179
Fastov-Piatikhakti	"	415
Debalzevo-Iassinovataia-Dniepropetrovsk-Krivoi Rog	"	497
Lvov-Ciop (partly)	"	240
Iassinovataia-Stalino-Mariupol	"	143
Costantinonka-Iassinovataia	"	51
Valuiki-Liski-Povorino-Penza	"	993
Miciulinsk-Saratov	"	451
Moscow-Gorki	"	439
Rusaievka-Inza	"	112
Magnitogorsk-Kartali	"	141
Kartali-Celiabinsk	"	279
Penza-Sizran-Ufa-Celiabinsk-Omsk-Irkutsk-Vladivostok	"	8809
Moscow-Iaroslav-Obozerskaia	"	1002
Moscow-Dimitrov	"	65
Moscow-Kuzovskaia	"	86
	Km.	23515

(1) See graphs C1 and C2.-

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	Km.	23515
Moscow-Naro-Fominsk.....	"	70
Novorossisk-Kruiskaia.....	"	53
Mineralnivodi-Kislodovsk.....	"	64
Baku-Alit-Tiflis.....	"	549
Kharkov-Iama-Nikitovka-Debalzevo.....	"	305
Novosibisk-Proiektnaia-Novo Kuznetsk..	"	449
Akmolinsk-Karaganda.....	"	232
Outern circular of Moscow.....	"	300
Total	Km.	25.537

Planned for the end of 1950

	Km.	25.537
Moscow-Briansk-Kharkov.....	"	859
Briansk-Konotop.....	"	256
Moscow-Riga.....	"	922
Gorki-Kirov-Molotov-Sverdlovsk-Tiumen-Omsk		2.314
Orsk-Kartali.....	"	271
Akmolinsk-Kartali.....	"	805
Sverdlovsk-Nizhi Tagil-Goroblagodatskaia	"	195
Zverevo-Debalzevo.....	"	154
Likaia-Stalingrad-Ilavlia-Saratov-Sizran	"	1.512
Riazan-Rusaievka.....	"	419
Inza-Sizran.....	"	195
General total..	Km.	33.439

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ANNEX n. 10

SITUATION OF WORKS ALONG THE NEW BUILT LINES (1)

1) KONOSHA-KOTLAS-VORKUTA line (km. 1563): single-track; ended and in regular service;

2) ALONG-THE-VOLGA line: ILOVLIA-SARATOV-SIZRAN-KINDIAKOWKA-ZELIENI DOL (km. 1024): in 1950 was ended and in regular service. Single-track.

3) BLACK SEA LINES. Section: ADLER-SUKUMI (km. 115): ended, single-track, electrified and in regular service.

4) CASPIAN SEA LINE: ASTRAKAN-CIERVLENNAIA UZLOVAIA (km. 442): ended, single-track, in regular service.

5) BALKASH LINE: Section : MOINTI-BEKKUL (about 450 km.): ended, single-track, but not yet in regular service.

6) AMU DARIA LINE: CIARDZHOU-KUNGRAD (about 650 km.), nearly ended and single-track, but not yet in regular service.

7) KUSBAS LINE:

- SECTION: an unspecified point of the KINEL-UFA with STERLITAMAK-TUKAN (km.?): under construction;
- SECTION: TUKAN-BIELORESK (about 120 km.) built and in service before 1945; single-track line;
- SECTION: BIELORESK-MAGNITOGORSK (about 100 km.): under construction;
- SECTION: MAGNITOGORSK-KARTALI (km. 141): built and in service before 1945; double-track line; it is being electrified;
- SECTION: KARTALI-AKMOLINSK (km. 805): built and in service before 1945; single-track line; they are laying the second track; under electrification;

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(1) See graphs C1 and C2.-

- SECTION: AKMOLINSK-PAVLODAR (about 428 km.): single-track, but not yet in service
- SECTION: PAVLODAR-KULUNDA (km. 138); single-track line and in service before 1945;
- SECTION: KULUNDA-BARNAUL (about 420 km.): single-track line but not yet in service;
- SECTION: BARNAUL-ALTAISKAIA (km.15): single-track line and in service before 1945;
- SECTION: ALTAISKAIA-GURIEVSK (km. 200): single-track line, but not yet in regular service;
- SECTION: GURIEVSK-BIELOVO (km. 28): single-track line and in service before 1945;
- SECTION: BIELOVO-NOVOKUZNETSK (km. 141): double-track line; electrified and in service before 1945;
- SECTION: NOVOKUZNETSK-ABAKAN (km. 260): not ascertained whether already built; surely not yet in service;

SECTION: ABAKAN-TAISHET (km. 650): under construction.

8) ISSIK LAKE-KUL-FRUNZE-RIBACIE LINE (km. 136): single-track and in service.

9) SEMIPALATINSK-MALINOVOIE-OSERO (km. 110): under construction.

10) ARALSK-BAIKONUR LINE (about 330 km.): not ascertained whether already built or under construction; surely not yet in regular service;

11) SOSVA-ALAPAIEVSK LINE (km. 150): single-track and in service.

12) KARA KUM LINE: URGENU-TAKHTA (km. 122): probably single-track built and in service for the construction of the TURKMENIA Canal.

13) ZIMLIANSK DAM LINE: KUBERLE-MOROZOVSKAIA: under construction.

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ANNEX n. 11

LINES SUPPLIED WITH AUTOMATIC SIGNALLING APPARATUS (1)

1)	MOSCOW-LENINGRAD-VIBORG	Km.	781
2)	MOSCOW-MINSK-VILNO-KALININGRAD	"	1289
3)	MINSK-BREST	"	349
4)	MOSCOW-BRIANSK-KIEV-LWOW	"	1484
5)	BRIANSK-KHARKOV	"	477
6)	MOSCOW-TULA-ORIEL-KHARKOV-LOZOVAIA-NIKITOVKA-ROSTOV	"	1351
7)	MOSCOW-OZHERELIE-VALUIKI-KUPIANSK-DEBALZEVO	"	966
8)	MOSCOW-RIAZAN-LISKI-MILLEROVO-ROSTOV-ARMAVIR-BAKU	"	2558
9)	ARMAVIR-TIFLIS	"	860
10)	DEBALZEVO-IASSINOVATAIA-DNIEPROPETROVSK-KRIVOI ROG		497
11)	KHARKOV-IAMA-NIKITOVKA-DEBALZEVO	"	305
12)	LOZOVAIA-SAPOROSIE	"	179
13)	RIAZAN-INZA-SIZRAN-KUIBISHEV-CELIABINSK-OMSK-NOSIBIRSK-STALINSK	"	3818
14)	LENINGRAD-MURMANSK	"	1450
15)	MOSCOW-IAROSLAV	"	275
16)	MAGNITOGORSK-KARTALI-CELIABINSK	"	415
17)	LIKAIA-STALINGRAD-SARATOV-SIZRAN-KAZAN	"	1512
18)	SAPOROSIE-APOSTOLOV-DOLGHITZEVO (about)	"	182
19)	GOROBLAGODATSKAIA-SVERDLOVSK	"	195
20)	LVOV-CIOP	"	269
	TOTAL	km.	19.212

(1) See graphs C1 and C2.-

ANNEX n. 12

LINES WITH HEAVY OR AT LEAST RENEWED PERMANENT WAY (1)

(X) - Leningrad-Murmansk	km.	1450
(O) - Leningrad-Viiborg	"	130
(X) - Moscow-Leningrad	"	651
(X) - Moscow-Minsk	"	747
(O) - Minsk-Vilno-Kaliningrad	"	522
(O) - Minsk-Brest	"	349
(O) - Moscow-Briansk-Kiev-Zhmerinka-Lwow	"	1484
(X) - Briansk-Kharkov	"	477
(X) - Moscow-Tula-Oriel-Kharkov-Lozovaia-Nikitovka-Rostov	"	1351
(X) - Moscow-Ozherelie-Valuiki	"	647
(O) - Valuiki-Kupiansk-Debalzevo	"	319
(X) - Moscow-Riazan-Liski-Millerovo-Rostov-Armavir-Baku	"	2558
(EO)- Armavir-Tuapse-Tiflis	"	860
(X) - Debalzevo-Iassinovataia-Dnepropetrovsk-Krivoi Rog	"	497
(X) - Kharkov-Iama-Nikitovka-Debalzevo	"	305
(X) - Lozovaia-Saporosie	"	179
(X) - Moscow-Iaroslav	"	275
(O) - Moscow-Veliki Luki-Riga	"	922
(O) - Moscow-Gorki-Kotelnic-Kirov-Molotov-Sverdlovsk-Kurgan	"	2117
(E) - Molotov-Goroblagodatskaia-Sverdlovsk	"	507
(E) - Goroblagodatskaia-Serov	"	190
(XX)- Serov-Sosva-Alapaievsk	"	250
(O) - Alapaievsk-Nizhii Tagil	"	128
(XXO)-Likhaia-Stalingrad-Iloveia-Saratov-Sizzan-Kazan	"	1512
TOTAL....	Km.	18.427

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(1) See graphs C1 and C2.-

.....	Km.	18.427
(E) - Saporosie-Apostolavo-Dolgintsevo.....	"	182
(XX)- Astrakan-Cievolennaia Uzlovaia.....	"	452
(O) - Lwow-Ciop.....	"	269
(X) - Riazan-Inza-Sizran-Kuibishev-Celiabinsk-Omsk-Novosibirsk-Gorga-Irkutsk-Dezhnevka-Khabarovsk-Vladivostok.....	"	9.283
(O) - Kartali-Celiabinsk-Sverdlovsk.....	"	526
(O) - (?) Valuiki-Liski-Povorino-Penza-Rusaievka	"	877
(O) - (?) Riazhsk-Penza-Sizran.....	"	650
(O) - (?) Miciulinsk-Saratov.....	"	451
(O) - (?) Povorino-Ilovlia.....	"	273
(X) - Magnitogorsk-Kartali.....	"	141
(XX)- Kartali-Akmolinsk.....	"	805
(XX)- Akmolinsk-Karaganda-Mointi.....	"	577
(XX)- Mointi-Bekkul.....	"	450
(E) - Novosibirsk-Novokuznetsk.....	"	449
(O) - Tonki-Kemerovo.....	"	38
(XX)- Akmolinsk-Pavlodar-Kulunda-Barnaul-Bielovo	"	1.250
(XX)- Novokuznetsk-Abakan.....	"	260
(XX)- Saratov-Urbach-Astrakan.....	"	675
(XX)- Frunze-Ribacie.....	"	136
(XX)- Ciardzhou-Kungrad.....	"	650
(O) - Kinel-Cikalov-Orsk-Kartali.....	"	598
(O) - Iaroslav-Bui-Kotelnic.....	"	758
(O) - (?) Moscow-Kazan-Sverdlovsk.....	"	1.667
(O) - Danilov-Obozerskaia-Arcangel.....	"	773
(XX)- Outer around Moscow line.....	"	300
(XX)- Konosha-Kotlas-Vorkuta.....	"	1.563
(XX)- Zverevo-Debalzevo.....	"	121
General total km.		42.601

NOTE TO ANNEX n. 12

These lines have been determined according to a study which takes into account the following elements:

a) the quantity of sleepers (185 millions), tracks (4,5 millions of t.) and sidings (2 millions of t.) put at the disposal of Soviet railways during the fourth five-year plan permits:
   - to build up or renew about 52.000 km. of single-track lines with 104.000 km. of rails having a weight of 43 kg. per metre;
   - to renew the sleepers of other 50.000 km. of tracks and sidings;

b) with the material at disposal had to be:

	Single-track railway lines km.	Double tracks km.	Station lines km.
- rebuilt	3758	6788	?
- built ex novo	7230	5712	8296

which in the total had to absorb about 54.000 km. of rails and an unspecified quantity of sidings;

- repaired 32.000 km. of railway lines in service by employing 50.000 km. of rails and un unspecified quantity of sidings.

From this fact it follows that during the five years had to have a permanent way new or in good conditions:

- km. 10,988 of main tracks;
- km. 12,500 of secondary tracks
- km. 32,000 of lines in general

that is to say a total of at least 45.000 km. of lines in general (36,5%) of the whole railway network).

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c) The lines which, according to a study of the German General Staff, had a heavy permanent way in 1940 (km. 19175) (X)

d) The lines built since 1941 with modern systems and according to the new rolling stock at disposal of USRR (XX)

e) The lines which according the fourth five-year plan had to exceed the prewar capability (O)

f) The electrified lines (E)

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ELECTRIFIED LINES (1)

ANNEX n. 13

Baku-Sabutski	km.	72
Mstà river-Torbino (on the Leningrad-Moscow line)	"	50
Moscow railway network	"	600
Leningrad-Oranienbaum	"	40
Ligovo-Gatacna	"	29
Saporosie-Nicopol-Dolghinzevo	"	182
Iassinovataia-Nikitovka-Debalzevo (?)	"	80
Sukumi-Samtredia-Tiflis	"	405
Poti-Mikha Tskakisi	"	40
Samtredia-Batum	"	106
Rioni-Kutais-Tkvibuli	"	25
Shorapani-Sacikheri	"	53
Khashuri-Vale	"	91
Mineralnie Vodi-Kislovodsk	"	64
Koshva-Vorkuta	"	459
Murmansk-Loukhi	"	445
Dioma-Ufa-Celiabinsk-Kurgan	"	747
Molotov-Garablagodatskaia-Sverdlovsk	"	507
Solikamsk-Kizel-Ciurovskaia	"	232
Akmolinsk-Karaganda	"	95
Novosibirsk-Novokuznetsk	"	449
Tallin-Ruena-Riga	"	369
Tiflis-Akstofa (East of Tiflis)	"	94
Nicolaiev-Kerson (?)	"	60
Verkhoturie-Bogoslovsk	"	136
Total	km.	5.430

(1) See graphs C1 and C2.-

EQUIPMENT OF THE LINES FED BY 3000V CONTINUOUS CURRENT

The first electrifications with 3000V continuous current were made following the system of transformer substations with concentrated power; the distance among the transformer substations was of about 40 km.

On the contrary, the recent electrifications have been made following the system of the distributed transformer stations (1).

The transformer stations of the first electric lines were equipped with converter groups. The transformer stations built after 1937 are equipped with polyanodic rectifiers emitting 2400 or 4200 kW at 3000V per units instead of 1000 up to 2000 kW of the converter groups.

The transformer stations are fed by three-phase current with lines at 6-6,6; 30-33 or 100-115 kV; the latter tension has been adopted for all the recent electrifications. In most of installations, and specially in the steppa regions, the transformer stations have transformers feeding burners along a range from 40 up to 50 km., including industries, kolkhos and sovkhos.

The contact lines are in general of polygonal type with only a cable at a height from 5,75 up to 6,40 m. above the rail. The relative shortness of copper recently compelled them to use for the carrying cables a cable composed of twisted steel strands wound with copper cables. The percentage of copper is only from 20 to 30%. The contact cables are of copper. As standards, they have tested almost all the types with an actual prevailing of simple standards of the Grey type, tubes, and above all wood poles. The catenary suspension is generally made by skew brackets similar to the ones used in Central Europe for the single-phase

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(1) In this system, the transformer stations do not have reserve groups, but are drawn near so that in case of stopping, the time interval betwwen the two transformer stations concerned is fed in satisfactory conditions.

electrified lines. As for the placement of the chainings, the average would be of 10 km. per day and with trains in motion. In France they succeed to place only 2 km. per day, but it is the traffic density which limits the efficiency of the shifts.

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TYPES AND CHARACTERISTICS OF ELECTRIC LOCOMOTIVES

ANNEX n.15

Series	Sourman sk soviet tski S. Geco	Vladimir Lenin VL 19 e 21	Vladimir Lenin VL 22	SITIBBC	Sergio Kirov SK 22 2 series	Sergio Kirov SK 23	Polit Buro PB 21 - 2 series	...23	... 23	... 20
Type	C C	C C	C C	C C	C C	C C	2C2	1CC1(1)	2DD2(3)	BB+BB(4)
Production year	1931	1932	1946	1931	1935	1947	1935	1937	1950	1951
Hour power HP	2775	2760	3700	3050	2760	3700	2760(2)	3500	5530	5800
Continuous power HP	2405	2430	3300	2550	2430	3300	2430(2)	3150	5110	5350
Hour traction stress. Tons	25	20	28	28	20	23	11	27	35	30
Total weight	132	114 ET 126	132	132	132	138	121 et 131	168	238	160
Traction weight tons	132	114 ET 126	132	132	132	138	65	128	184	160
Maximum load per axle. Tons	22	19 ET 21	22	22	22	23	21.7 et 22.5	21	23	20
Total length.....m.	16.47	16.00 ET 16.22	16.40	16.50	16.01	16.01	16.36 et 16.58	18.80	27.08	24
Diameter of driving wheels m.	1.20	1.20 et 1.22	1.22	1.20	1.20	1.22	1.850	1.22	1.120	1.20
Top speed km/h	65	75	85	65	90	95	115 et 130	85	110	160

(1) Prototype electric locomotives built in two models.

(2) This electric locomotive is equipped with three double motors.

(3) 15 electric locomotives of this type were built in 1949 in U.S.A. but were not delivered.

(4) These electric locomotives were already built as electric-diesel of 2000 HP. A prototype would exis with single phase current at 50 Hz and rectifier.

ANNEX n. 16

RAILWAY SECTIONS

SECTIONS	DEPARTMENTS
North-Western	KIROV (Murmansk) KALININ (Veliki-Luki) LENINGRAD (Leningrad network) OCTOBER (Line Leningrad-Moscow) ESTONIA LATVIA NORTHERN DEPARTMENT (Arcangel) PECHORA (Kotlas-Vorkuta)
Western	LITHUANIA WESTERN DEPARTMENT (Kaliningrad) WHITE RUSSIA BREST LITOVSK
South-western	SOUTH-WESTERN (Kiev) VINITZA KOWEL LWOW ODESSA KISHINAU
Central	IAROSLAV GORKI MOSCOW-RJAZAN MOSCOW-KURSK MOSCOW-DONBAS (Moscow-Valuiki) MOSCOW-KIEV MOSCOW (Outer circular line)
Donetz	NORTHERN DONETZ SOUTHERN DONETZ SOUTH (Kharkov) SOUTH-EASTERN (Voronesh-Likhaia) STALINGRAD STALIN (Low Dnieper-The Crimea)

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SECTIONS	DEPARTMENTS
Volga	KAZAN KUIBISHEV ORIEMBURG (Cikalov) RIAZAN-URAL (Saratov)
Ural Siberia	PERM (Molotov) SVERDLOVSK TOMSK SOUTHERN URAL (Celiabinsk) KARAGAND:
Middle East	TURKESTAN-SIBERIA (Turk-Sib) TASHKENT ASHKHABAD
Far East	KRASNOIARSK EASTERN SIBERIA (Irkutsk) TRANSBAIKALIA (Cita) AMUR FAR EAST (Khabarovsk) PRIMORIE (Vladivostok) SAKHALIN

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DATA ON THE GOODS TRAFFIC (1)

ANNEX n. 17

Year	Transported goods millions of t.	Average length of transportation (Km.)	Goods movement milliards t.km	Daily average loaded cars (thousands)	Average repair time (days)	Daily average cars in service (thousands)	Average load per car (tons)
	A	B	C	D	E	F	G
1913				27.4			
1933	268						
1934							
1935	375			68.1(?)			15.09
1936	400						
1937	484			89.8(?)			
1940	593	700	415	97.8	7.37	721	16.59
1941	664 (2)	693 (2)	460 (2)	107 (2)			17 (2)
1942	271	823	223	42.6	13.52 (7)	576 (7)	17.4
1943	296	851	252	45.5	13.18 (7)	600 (7)	17.8
1944	370	830	307	55.4	11.73 (7)	650 (7)	18.3
1945	395	794	314	61.8	10.92	675	17.51
1946	455	743	338	69.5	10.07	700	17.94
1947	499	710	354	76. 2	9.61	732	17.94
1948	606	743	450	90.9	8.68	789	18.25
1949	712	737	525	105.4	8.08	852	18.50
1950	771 (5)	690 (5)	532 (5)	115 (5)	6.96 (5)	800 (5)	18.37(5)
	821 (3)	732 (3)	601 (3)	118.4(3)	7.7. (6)	915 (6)	18.91(3)
1951	928	725	673 (5)				

The data of columns D, E, F, G, concern two-axle conventional cars.

NOTES TO ANNEX n. 17

(1) Drawn directly or through calculations from data of Soviet official source. Relations binding the different data of the schedule: A.B. = C D.E. = F 365.D.G. = A

(2) From tha data of the first six months.

(3) Official report on the results of the fourth five-year plan.

(4) Official report on the result of the 1951 plan.

(5) Previsions of the fourth five-year plan.

(6) Estimated datum by considering the annual increase of wagons availability.

(7) Estimated according to the following reasoning: being excluded that after a year of war the conservation of wagons (and consequently the percentage of the cars being repaired) was quite different from the one of the prewar period, it is to be admitted that the daily average of the cars in service (that is the one giving the effective possibility of transportation of the system) depended only upon the availability of cars. Now, being it known that the availability of cars in 1942 was equal to the 80% of that of 1940, we can take for granted that the daily average of the cars in service in 1942 was equal to the 80% of that of 1940 and consequently of 576.000. Now, if with 576.000 cars in service only 42.600 cars per day could be loaded, it means that the average repair time in 1942 was of 13,5 days. The same can be said for 1943 and 1944 by taking the datum of the cars in service among those included between the datum of 1942 and the known one of 1945.

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Among the elements having an influence on the average repair time (average length of transportations, loading and unloading times, speed of the trains, stopping in the shunting and movement stations between the place of loading and places of new loading) it is officially known but the value of the average length of transportation.

By studying the repercussions which the variations of average length of transportation and speed have on the average repair time we can for instance observe that on a repair time of 7 days corresponding to the distance of 700.km. covered by trains having an average velocity of 20 km/h (1)at a parity of any other condition:

- a positive variation of 50 km. in the distance, that is to say of 7,14%, brings a positive variation of the repair time of 2,30 hours, corresponding to 10,4 cents per day,i.e. of 1,48%;
- a positive variation of 5 km/h of velocity of the trains i.e. of 25% brings a negative variation in the repair time of 11 hours, corresponding to 45,8 cents per day, i.e. of 6,54%.

It follows that positive variations of the average length of transportation and of the trains velocity not only have repercussions separately limited on the average repair time, but if have the same sign and occur contemporaneously, tend to be elided.

Consequently, by considering that the average repair time of 1950 is of 4,45% higher than the one of 1940, while contemporaneously that of the average distance length is of the 4,6%, it follows that not only the increased average distance had an influence on the increased average time of run.

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(1) That is to say, to set apart the velocity which is not known, in the conditions foreseen by the five-year plan.

By excluding that on such increase have had an influence:

- an increase of the loading and unloading times wich either in consequence of the Government's pressure on the users or in consequence of the modern systems which are being used ought to decrease;
- a reduced velocity of the trains, which owing to the improvements of the lines has on the contrary increased,

we come to the conclusion that it is owed to an increase of the times of stopping and movement between unloading and new loading.

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ANNEX n. 19

TRAFFIC INTENSITY - YEARLY EFFICIENCY - PERCENTAGE CARS OUT OF USE

Year	Railway network length (thousands km)	Consistence cars park (thousands cars)	Daily average cars in service (thousands)	Transported goods (millions of tons)	Goods movement (milliards of tons-km.)	Traffic intensity (tons) (1)	Efficiency per car(2) (thousands)	Percentage cars out of use
1940	106	893	721	593	415	5.594	464	19.3
1950	123	1.170(3)	915	821	601	6.674	514	21.8

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(1) - Tons of yearly transported goods per km. of line

(2) - Tons/Km. per car yearly

(3) - Taking into account the construction plan of cars fallen back of a year

ANNEX n. 20

LENGTH OF TRAVEL OF THE SPEEDEST TRAINS ON THE GREAT SOVIET LINES AND NUMBER OF DAILY COUPLES CONNECTING THE INDICATED RAILHEADS.

Line	Length of distance covered km.	1949 Length in hours	1949 Hour speed Km/h	1950 Length in hours	1950 Hour speed Km/h	Daily couples
Moscouw-Leningrad	651	12	54.3	11.45	55.2	13
Moscouw-Zhmezinka-Odessa	1510	40	37.7	39.20	38	1
Moscouw-Voronrsh-Rostov-Baku	2542	72	35.3	70	36.3	2
Moscouw-Kharkov-Rostov	1351	-	-	24.18	54(1)	10
Idem	1351	31	43.6	29	46.2	
Moscouw-Bui-Sverdlovsk-Vladivostok	9344	219	42.6	219	42.6	2
Moscouw-Pensa-Celiabinsk	2102	58	36	58	36	2
Moscouw-Saratov-Alma Ata	4030	119	33.8	117	34.4	2
Moscouw-Minsk-Kaliningrad	1289	35	36.8	34	37.9	2
Moscouw-Minsk-Brest	1099	28	39	26,30	41,4	3
Leningrad-Murmansk	1450	46	31,5	39	34.3	4
Moscouw-Arcangel	1131	34	33	31	36.5	1
Novosibirsk-Semipalatinsk-Tashkent	2671	91	29.2	89	30	1
Tashkent-Krasnovodsk	1862	60	31	61,30	30.2	1
Moscouw-Stalingrad	1073	36	29.8	35.20	30.3	1
Fastov-Dniepropetrivsk-Iassinovataia	797	21.40	36.8	21.40	36.8	1
Moscouw-Riga	922	26.15	35	26	35.3	2
						3

(1) - Diesel railway car.

ANNEX n. 21

EXCERPT FROM THE FIFTH FIVE-YEAR PLAN OF USSR

COMMERCE - TRANSPORTATIONS - COMMUNICATIONS

.....

To plan for 1955 with regard to 1950 an increase in the goods transportations of 35-40% by train, of 75-80% by waterways, of 55-60% by sea, of 80-85% by motor transportation, of at least twice by air and an increase of transportations of liquids and gas by ducts of about five times.

To consider as fundamental duty in the field of railway transportations an increase of the traffic capacity of the railway lines. Consequently:

a) to increase of about 60% compared with the last five-year plan the putting in service of the second track and to quadruple the electrified lines. To bring the length of the dead-end sidings up to the 46% of the railway lines length open to traffic;

b) to build and open permanently to traffic new railway lines, two and a half as many times as in 1946-1950. To end the construction of the main line of southern Siberia on the sections from Abakan to Akmolinsk. To end the construction of the railway line Ciargiou-Kungrad and to begin the construction of the line Kungrad-Ieniseisk. To develop the construction of the railway lines Krasnoiarsk-Ieniseisk, Guriev-Astrakhan, Agryz-Pronino-Surgut. To make the necessary works to rebuilt the railway lines in the Soviet Socialist Republics of Lithuania, Latvia and Estonia;

c) to increase within the end of the five-year plan by about the 80%, compared with 1950, the length of the railway branches having automatic blocks and multiply by at least 2,5 times the length of the branches having automatic signalling apparatus. To increase by about 2,3 times the number of the points electrically operated. To increase considerably the use of the system of centralized movement direction. To ensure further mechanization of switching lines. To continue the required works to introduce the radio connection while directing the trains movement and during the maneuvres.

d) to improve the railway network conditions. To supply within 1955 the railway transporations with an increase of rails exceeding by 85% that of 1946-1950;

e) to meet all the requirements of railway transportations concerning steam and electric locomotives, goods cars, isothermal and passenger cars. To end the automatic coupling of all the wagon park and to supply the rolling stock with ball bearings. To begin the production of new powerful locomotives, electric locomotives, Diesel locomotives and locomotives supplied with gas generators.

To improve the employment of the rolling stock; to reduce within 1955 in comparison with 1950 by at least 18% the time the wagons take to cover a distance and to increase the daily average distance covered by locomotives by at least 12%.

To considerably improve the exploitation of the loading capacity of wagons and to increase the tonnage of goods trains. To ensure the applying of measures aiming to improve the work organization of personnel attached to trains movement and above all of the engine driver and stoker sets.

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